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WHAT WILL THEY DO WITH IT?

The cry which was perceived some months since, and mentioned in our columns from time to time, notably in the leader of March the 10th, has now come close at last, and that cry is "More capital."

One of the companies, which has already increased its capital once (to pay for patents), has now resolved to ask for more capital to carry on its work, and this company will probably be but the forerunner of many others.

The Maxim-Weston Electric Company, formerly called the Electric Light and Power Generator Company, was started in April, 1881, and we perceive by the report of the directors, an abstract of which is published in this issue, that the capital taken up to this date is (after deducting £2 10s. for calls in arrear and adding £72,500 for £1 shares issued to vendors and patentees as fully paid) £172,497 10s. To this again is added creditors £3,657 13s. 11d., and sales of concessions and patent rights £30,000, giving a total of £206,155 3s. 11d. On the other side of the balance-sheet we find:—Patents and fees, £113,819 15s.; Parliamentary expenses, £923 7s.; machinery and stock at factory and employed on contracts, £21,372 12s.; lease, building, and furniture, £2,390 16s. 9d.; shares in other companies, £19,625; debtors, £14,456 12s. 5d.; cash at bankers', £783 6s. 10d.; and the expenditure to March 31, 1882, £16,480 19s. 2d.; and to March 31, 1883, £16,302 14s. 1d., giving a like total of £206,155 3s. 11d.

What profitable business, beyond sales of concessions, has this company done? Even the amount received from these concessions is more than equalled by the two years' expenditure. The one figuring as £30,000 against £32,783. Two years of efforts of varying directors, scientific advisers, managers, secretaries, &c., and on this large capital there has been not one penny of dividend, nor can we see that there is likely to be for a long time to come, and the cash at bankers now figures at £783 6s. 10d.

The difficulty of asking for more money under such circumstances must have been very great, and the directors are to be congratulated on their skill and address in drawing up their report with such nice discrimination and with such careful rounding off of rough and ugly points. At the extraordinary meeting which it is intended to hold, as we go to press, it is purposed to ask the shareholders to consider the advisability, or otherwise, of increasing the registered capital from £172,500 to £500,000, and that the new 327,500 shares (nominally of £1 each) may be allotted *at the discretion of the directors, on such terms* and *at such times as they think fit*, and *either at a premium or at a discount.*

That the directors must have more money or wind-up seems inevitable, but whether the prospects of the Company are sufficiently good to warrant so extensive an issue, with such *wide powers* to the directors, is a matter which requires the most complete and exhaustive inquiry on the part of the shareholders. We think that the shareholders will do well to look the matter boldly in the face now, rather than consent to issuing more shares at a considerable discount, perhaps only to find themselves in a worse position twelve months hence than they are at the present moment. As we pointed out in the article of March 10th, the demand for electric lighting is very much exceeded by the supply, how then can it be profitable to increase an already extensive capital account? Of course, we quite appreciate the difficulty of the directors, but before shareholders allow good money to go after bad, let them well consider and ask themselves the question—When the directors have this money, what will they do with it?

THE MEASUREMENT OF ELECTRICITY.

By JAMES N. SHOOLBRED, B.A.

(*Continued from page* 305.)

Registering Instruments.

These may be divided into two classes—1st, quantity, or coulomb-meters; and, 2nd, energy, or work-meters.

1. *Quantity, or Coulomb-meters*—These, again, are separated into those based upon, *A*, *electrolytic* action, and those which are, *B*, *mechanical* in principle.

A. Electrolytic.

Mr. Shoolbred commenced with Edison's current-meters, which, as our readers are aware, are based upon electro-deposition of metal, due to the action of a known fractional part of the total current. The weight of the increments is ascertained periodically, and from it the total quantity of the current which has passed during the interval is deduced.

The metal now generally used consists of plates of amalgamated zinc, immersed in a solution of 90 parts of sulphate of zinc and 100 parts of pure water.

In the form of meter for commercial use, two cells are placed as a check against one another; one, termed the "monthly cell," receiving four times the current of the other, which is known as the "quarterly cell."

In order to prevent the temperature of the liquid in the cells falling so low as to freeze, a connection is made, by means of a long thin strip of brass and steel riveted together, to an incandescent lamp, which is thereby lighted and raises the temperature as required. It is only when the temperature falls to 42° Fah. that this tongue is sufficiently depressed to form contact, and so to light the lamp. On the temperature rising the tongue rises, and the lamp is extinguished.

Experience shows that electro-deposition, to give a true and reliable record, should not be forced or overworked in its action; and that the plates should not in their daily duty be required to do more work or be longer in action than they are intended for by their superficial area. In practice, about 75 per cent. only of the nominal work should be required of them. It appears to be the custom to design the duty of a meter for three hours burning of each lamp per night. Thus, a 25-light meter would have its plates designed for 75 lamp-hours per night. As just stated, it is not advisable, in practice, to exceed 75 per cent. of this amount. However, it is seldom found that the whole of the lights are used for the entire of the time allotted to each, and, if this were so, it would merely require a larger meter to meet the case.

At the present moment it is understood that over three hundred meters on this principle are in use in New York.

Sprague's Meters.

These instruments are based upon electro-deposit up to a certain point, *i.e.*, when the intended quantity of metal, whether copper or zinc, has been deposited on the plate. The current is then reversed, and the metal gradually dissolved again until the primary condition of the plate is reached; when, by another reversal of the current, deposition again commences. Each reversal of the current is recorded by a mechanical counter and a train and wheels.

Not much practical experience has so far been obtained with these meters; but, what has been done, tends to point out that the mechanical operations involved in the reversals of the current, and in their registration, absorb a large amount of power.

B. Mechanical.

Hopkinson's Current-meter.

This instrument consists of a thick wire coil, in the form of a solenoid, through which the current passes to be measured. The iron core of this solenoid revolves with its central shaft by the action of the armature of a small dynamo machine, placed at one end of the shaft.

The core of the solenoid is in two parts; the lower is fixed to the shaft, while the upper is movable, being attached to a governor-ball

arrangement, and sliding up and down the shaft in accordance with the variations in the rotation speed of the shaft. A shunt current passes through the dynamo and its armature, then up through the lower or fixed portion of the core, and (by contact only) to the sliding part, and thence to the framework of the apparatus.

If the movable core be lifted, owing to the speed of rotation by the action of the governor-balls, this circuit is broken, and the shunt current through the dynamo interrupted. Whenever a current to be measured passes through the coil, attraction, by means of its casing, takes place between the fixed and the movable parts of the iron core.

This magnetic action, which is proportional to the square of the current, tends to keep the two parts of the core together and in contact; while the centrifugal force of the governor-balls, which is proportional to the square of the speed of revolution, tends to break the contact by lifting the movable part. These opposite forces will, in working, balance one another, and the result is that the system revolves with a velocity proportional to the current through the coil.

As the revolutions of the shaft are transmitted continuously by a train of wheels to a set of index dials, a record is thus kept of the quantity of the current that has passed.

BOYS' QUANTITY, OR VIBRATING-METER.

This instrument is based upon two well-known principles. 1. The force acting on the armature of an electro-magnet, in any position, is proportional to the square of the current. 2. The square of the number of vibrations, say, of a pendulum, is a measure of the controlling force.

Therefore, if the controlling force under which a body vibrates is due to the action of an electro-magnet on its armature, the square of the number of vibrations in a given time is a measure of the square of the electric current. In other words, the rate of vibrating is a measure of the strength of the current, and the number of vibrations is a measure of its quantity.

The exact form and nature of the meter may vary in many details. The one now shown consists, primarily, of an electro-magnet (the upper one), through the coils of which passes a portion of the main current to be measured. This magnet is placed horizontally, and a vertical rocking shaft stands between its poles. This shaft has fixed on it a soft iron armature, rounded at the ends, and free to move in the horizontal plane between the poles of the electro-magnet.

The intensity of the attraction between the poles and this armature determines the rate of vibration; which, as above stated, is a measure of the strength of the current. Each vibration is itself recorded by means of an escapement, a train of wheels, and a set of index dials; and the number of vibrations thus registered becomes a measure of the quantity of the current. To add to the momentum of the vibrating body, two long arms, weighted at the end, are attached to the lower part of the vertical shaft.

In order, likewise, to prevent the vibrating armature from gradually coming to rest, it is arranged that when the vibrations fall below a certain limit, by making contact, a portion of the current is sent round the coils of a second or "impulse" electro-magnet (placed underneath the "controlling" magnet), and which has an armature of a suitable form fixed on to the same shaft that carries the armature of the upper magnet. The extra motion thus given to the shaft, by the attraction of the lower armature, affords the necessary impulse to the vibrating armature when required to do so.

2. ENERGY, OR WORK-METERS.—BOYS' ENERGY-METER.

This instrument consists of two parts—1st, the indicator of energy; and, 2nd, the integrating apparatus.

1st. In the indicator of energy, a balanced beam has from one end suspended a counter-weight, and from the other a hollow solenoid, free to work up and down into two other solenoids. The movable solenoid is wound with a considerable length of fine wire; in the upper half in one direction, in the lower in the opposite (this is to render it independent of any magnet which may be placed near to it). This solenoid constitutes the high resistance shunt which measures the E.M.F. The two fixed solenoids are wound with thick wire, and convey the main current.

The result of the action of the fixed and the movable solenoids on each other is a force proportional to the product of the two currents, that is, to the energy expended; but the external evidence of this is the inclination of the beam, and this inclination, or rather the tangent of the inclination, is proportional to the energy being expended.

2nd. The recording apparatus consists of a cylinder, which by means of a mangle-motion is made to reciprocate backwards and forwards by clockwork, and during its passage in each direction the cylinder is made to bear alternately against one of two tangent wheels, each free to be inclined in its direction of travel; both are fixed on the same swivelling frame, but only one of them bears at the same time against the cylinder.

This frame is free to be inclined from the vertical in correspondence with the inclinations of the beam above mentioned.

The effect of this inclination of the tangent wheel is to cause the reciprocating cylinder to rotate, the speed of such rotation being proportional to the tangent of the inclination of the wheel, which is likewise proportional to the tangent of the inclination of the beam; that is, to the amount of energy expended. The path of the tangent wheel on the reciprocating cylinder, when not inclined, is simply a straight line lengthways along the cylinder, and no rotation is caused; but when, owing to the inclination of the wheel, the cylinder rotates, the wheel-path becomes a spiral.

The rotations of the cylinder are transmitted to a train of wheels and registered; thus giving a record of the amount of energy expended during a given time.

DEPREZ'S ENERGY-METER.

This instrument consists of a thick wire coil movable upon its axis, which passes through its centre of gravity. This axis-shaft is set upon two knife-edges, insulated from each other, and communicating respectively with the coil; and with a metal bar having a curved, quadrant-shaped head, which dips into a mercury cup, and thus forms connection with the main current. The shaft also carries, projecting downwards, a pendulum rod, the bob of which is intended to cause an antagonistic force; while the extension, upwards, of the rod forms a pointer, with the scale fixed on the frame of the apparatus. On the frame there is also a fine wire coil, on a shunt, fixed so as to surround the movable coil.

The deflections on the pointer are therefore due to the product of the intensity of the current and to its electromotive force; that is, to the power developed.

The readings of this instrument may be integrated, either by a Deprez rotating disc and ball integrator, or by one designed by Abdank (of Cracow), having a travelling cylinder and tangent-wheel arrangement, somewhat similar to that of Boys'.

AYRTON AND PERRY'S ERG-METER.

This was described and illustrated in the ELECTRICAL REVIEW for March 17th.

The brief review just made of the subject of the measurement of electricity, said the lecturer in conclusion, as well as of some of the instruments employed in it, will, it is hoped, tend to show that measurement of a very precise nature can be made; more so, indeed, than perhaps in any branch of physical science. Also, that a large number of very effective instruments already exists; and that, even in the class of registering instruments, or "meters," much has already been done, and to which additions are being made almost daily.

DISCUSSION.

Prof. W. Grylls Adams, F.R.S., said that, although called upon by the chairman to open the discussion on this interesting subject, he was scarcely prepared to do so, as he had only just arrived from a long journey, nor was he prepared to discuss the numerous points brought forward in the paper. The first part dealt with the important subject of the theoretical, or C.G.S. system of units, and their relation to the practical units, which were so clearly put before the public by the chairman, at the meeting of the British Association at Southampton. Mr. Shoolbred had passed rapidly in review the various instruments for measuring currents, electromotive force, and electrical energy; but before much could be said about them, they required further trial and comparison with one another. Of course every inventor was persuaded of the merits of his own instrument; but there had not yet been a sufficient comparison made between them by the same person to enable any definite conclusion to be come to as to which was the best. One important point was economy; a simple instrument would have the preference over another which might be equally effective but more complicated. If these instruments were to be used by every consumer, it was a matter of great importance that they should not be unnecessarily expensive.

Mr. R. Hammond, as one who was engaged in the commercial development of electricity, felt that the best thanks of the society were due to Mr. Shoolbred for the able manner in which he had treated the subject. It seemed to him, the greatest problem before the scientific world was how to measure the electric current. When an endeavour was made to get the inhabitants of a town to adopt electric lighting, the one great objection constantly put forward was, how was it to be paid for? In old days, probably every one went to bed at the same time—when it got dark; but people's habits differed very much in that respect now, and they said they did not want to pay so much a-year, but in proportion to the light they made use of. Therefore some method of measuring electricity, without consuming current in doing so, was one of the greatest problems of the age. However gas might be improved, it could never be made to burn without taking oxygen from the air, and giving back poisonous gases; and on that account alone, though electricity might cost four or five times as much, many people would prefer it on the score of health and comfort In the early part of the paper, Mr. Shoolbred had reminded them of the names given to the tools used in electric science, and he thought this very useful, for many persons were not yet familiar with them. At one time, no doubt, the division of the day into hours, minutes, and seconds seemed equally abstruse, and was not readily followed, but immense advantages had been gained by the adoption of these terms, and no doubt before long people would become equally familiar with ohms, farads, and coulombs. He looked at these instruments with great interest, but he did not think any of them would meet the demand. When they came to distribute 60,000, or six millions of lights in London, which was about the number of gas-jets, something more simple would be required. They were but the rudimentary instruments, out of which the tools of the future would have to be made. They wanted something as simple as a gas-meter before they could compete with the twenty millions sterling invested in gas in London. He hoped, however, that out of some of these instruments would come something which would enable them to answer the question how they were to charge their customers. As a member of the public, he would recommend electricians, if they could do so, to introduce a unit equal to a thousand feet of gas, which might be called a "Siemens;" but whatever was the name adopted, let electric light companies be able to make charges comparable with those made for gas.

Mr. F. Varley described the capabilities of his meter, and said he regretted he could not fully explain the principle and mode of action, owing to the foreign patents not being yet obtained. This meter was intended to give six months' reading for 100 incandescent lamps of the Edison pattern, assuming they took ·7 ampères per lamp; and the hand would show, in hundreds of thousands of coulombs the amount of current which passed. When the man took the state of the meter, he reversed a switch, and it went back again. In Sprague's electrolytic meter there was a reciprocating action, by which when one plate became heavy, it descended and reversed the action,

and the fault alleged was, that a considerable amount of current was absorbed in the mechanical action, which gave no record; but if this loss were spread over six months, it would be inappreciable; and that was the system on which he worked. He could obtain a record, either in volts or ampères, and there was also an energy-meter, formed by a combination of the motions derived from the volt-meter and ampère-meter. He agreed with Mr. Hammond that it was of great importance that meters should be simple, and that all sources of error should be reduced to a minimum, but the mechanism of this was as simple as possible. What was wanted in a meter was a self-recording apparatus to show what was going on; that in fact, the current should write a journal of its proceedings. In the volt-meter, which he hoped soon to be able to describe fully, there were two actions—one of which would give the aggregate amount of work done, and the other all the variations which took place; so that, if the current increased or decreased, it would all be shown on the diagram as in a recording barometer. He fully appreciated what Mr. Hammond had said with regard to gas, and his desire to have a unit which should represent a thousand feet of gas; but he would ask if any one in that room could state the amount of light which could be obtained from a given amount of current? He was at present engaged on experiments in this direction, and had already obtained some remarkable results from flexible carbons with very small potential; in fact, with four ampères and a potential of forty volts, he had obtained an arc giving a light of five hundred candles.

Mr. Blakesley said that at the present time there were 80 Provisional Orders undergoing incubation in the genial atmosphere of the Board of Trade, to grant to limited companies a more or less practical monopoly of the distribution of electricity; and it was therefore of the utmost importance to the public to know something about electric measurements. It was not at all wonderful that companies should seize every advantage they could, but it did seem strange that the Board of Trade should meet them more than half way; and there was one flaw in the model clauses which had special reference to the subject of this paper. They were told that electric energy was measured by the E. M. F. × time × quantity; that the quantity would have to be measured in one of these meters, and then to be multiplied by what was to be called the standard pressure or potential; but this pressure was to be allowed to vary at different times of the day. The companies were going to integrate the time, and multiply that by a certain current which would be the maximum current a man could ever want, and that again by the standard potential, which might have two values in the same place on the same day. It appeared to him the authorities should insist on the measurement of quantities, and also on a certain standard of potential being maintained. Nothing had been said about the mode of measuring alternating currents, but he did not think it advisable that such currents should be allowed.

Mr. C. V. Boys, said there was not time for him to make more than one or two remarks upon the main features of his instruments. Mr. Hammond had referred to the complication of the energy-meter on the table, but it was only fair to say that that was made from the first drawings ever prepared, and it was hardly likely that such an instrument would be as simple as it might be. The one point of importance in connection with both the energy-meter and the current-meter was that there was no possibility of tampering with them by magnets. He had done his best to make them both entirely independent of any magnetic field in which they might be placed. In the current-meter the only movable part made of iron was entirely enclosed in iron, which would shield it from the action of any external magnetism. In the energy-meter, the only movable part which could be affected had an equal number of turns in opposite directions, so that any magnetic effect would be neutralised. It was true that if the field in which the instrument was placed was suddenly changed, as by the insertion of a magnet within the case, its indications might be affected; but it would be just as easy to drive a poker through the whole affair, which would also affect it.

Mr. W. H. Preece, F.R.S., speaking as one of the disciples of electricity, ventured to say that whenever a demand had been made on electricity to do anything it had always responded to it, and if householders did require apparatus on their premises as simple as a gas-meter, to record what was going on, he was quite certain it would be supplied. There were certain instruments on the table which, compared with gas-meters, looked rather complicated; but he should like to ask if there were six men in the room who could describe and explain a gas-meter; and, if they could, whether they would be kind enough to compare the construction of a gas-meter with that of one of the proposed electric meters. His own experience was that, in its principle and construction, a gas-meter was more complicated than anything which had been brought forward that night; and if the question of measuring electricity was to be overcome by simplicity of mechanical arrangement, he was sure they would be produced in a way which would far surpass anything now used by gas companies. Unfortunately, there had not yet been much experience of these things, and he doubted if any one else present could speak of having measured electricity by meter. For many months at the Post-office, however, they had had a portion of the premises illuminated by electricity in a way which had given the most perfect satisfaction, both as to its efficiency, healthiness, and comfort; and they had been measuring it by means of meters, in order to arrive at some conclusion as to the practicability of those instruments. They found that, in practice, currents of electricity could be measured with an exactitude quite equal to that of gas, the error being under 2 per cent., and they had been tested by the most skilled electricians. He rather went with Mr. Hammond in some of his observations, and he must say that within the last few days he had been negotiating a mode by which lighting might be paid for, not by measuring the quantity of electricity consumed but by the measurement of the amount of light given as compared with that given by 1,000 feet of gas. What was supplied and used was light, and what people wanted to pay for was light. 1,000 feet of gas gave a very convenient standard, and if the electric light companies could only formulate some plan by which they would charge accounts for the light supplied, he believed the public would be more ready to use it than if they were charged per volt-ampère, or any other measurement which a few understood but the majority did not. The most interesting subject was not how electricity was to be measured but how was it to be paid for? Mr. Boys' instruments were perfect of their kind, and Dr. Hopkinson's instrument for measuring the quantity of electricity passed into a house, though very little known, was one of the most perfect things he had ever seen Why he objected to pay for electricity was because he believed with Mr. Varley they did not know how much light it would produce. If they agreed to pay 7d. per 1,000 volt-ampère-hours this year, the probability was that next year such improvements would be made that the same energy which now produced 200 candle-power would then produce 2,000, and it was absurd to restrict oneself to a certain payment for a thing which was in such a variable state of improvement. Mr. Blakesley had referred to some clauses in some supposed Board of Trade Provisional Order, which would allow of variation in the electric pressure; he did not know to what he referred, but it could not be to the final clauses issued by the Board of Trade, for they were not yet published.

Mr. Blakesley said he referred to the clauses issued in February.

Mr. Preece said those clauses were not issued by the Board of Trade; they were prepared by some of the companies, as drafts to be sanctioned by the Board. It would be found when the Provisional Orders were issued—which would probably be that week—that a fixed standard pressure would have to be maintained during the whole twenty-four hours.

Mr. Shoolbred, in reply, said the only point he desired to touch upon was the important one raised by Mr. Hammond. In several of the Provisional Orders sent in, especially on the part of local authorities, there was a distinct provision for a payment for so many candles of light; and in some cases it was distinctly provided that it should not exceed by so much the price allowed for so many standard candles, according to the Gas Act in that particular locality. There was evidently a desire to meet what was in Mr. Hammond's mind, and what Mr. Preece also seemed to approve of, viz., to make the payment for electricity depend on the light supplied, as compared with that of gas.

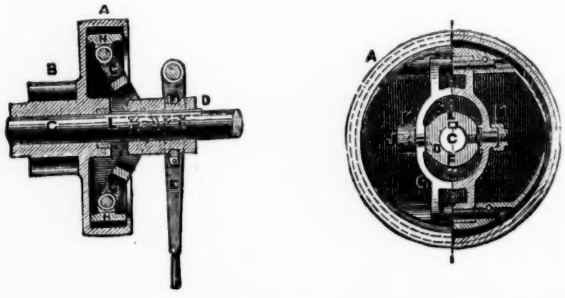
The Chairman, in proposing a vote of thanks to Mr. Shoolbred, said the importance of the subject was proved by the great amount of skill already brought to bear upon it within very recent times. Several instruments which were now exhibited, showed that there was more than one way in which the measurement of the current might be effected. And that either in the form of quantity or intensity, or of both combined. You might get indications of the amount of electrical energy passing at the time, which was important, and also, what was equally necessary, a record of what had passed in a given time; because it was of no service to the consumer to tell him, at this moment you are receiving a current of so many ampères of such a potential; he wanted to know how much he had to pay at the end of the year. With regard to Mr. Hammond's proposal that the unit might be one which would compare directly with 1,000 cubic feet of gas, he must say there were certain difficulties connected with it. First of all he should like to know what 1,000 feet of gas ought to do; the gas supplied in London did not do nearly enough; then, again, there was the question what burner was used. Electricity had one decided advantage—that you could only supply one quality; and it appeared to him that it would be to the benefit of the consumer not to take the dictum of Mr. Varley, or any one else who said, "I can produce a 1,000 candle-power with a current which, in the hands of another person, would only yield 500." No doubt the public would claim the advantage of all these improved lamps, and improved modes of utilising the current; but considering that the electric current of a given potential and representing so many ampères was a definite quantity which could not be tampered with or altered, he thought it would be best for the customer to have measurement. The meter, or recorder, should give at the end of the month or quarter the exact amount of electricity supplied expressed in watts, or any unit of a larger kind, which might be fixed. One of those units would be capable of producing as much light in an hour as so many cubic feet of gas of a given quality, and burned in a standard burner. It would not be difficult to establish a relation between the two things; but the measurement of electric energy, whether used for lighting or for the transmission of power, should be an absolute measure. Such discussions as these were very useful in fixing one's ideas with regard to these matters, and though they might not all be agreed on one definite mode of procedure, yet no doubt they would all go home to think over the subject, and the result would probably be a clearing away of the cloud which now hung over the whole question.

The votes of thanks to Mr. Shoolbred, and to the gentlemen who had lent instruments for exhibition, were passed unanimously, and the meeting adjourned.

The Daft Electric Motor.—Mr. Leo Daft, a graduate of London University (says the *Operator and Electrical World* of New York), claims to have perfected an electric motor which will soon supersede horse-power on our street railways. His experimental line is at Greenville, N. J., and is about one-eighth of a mile in length, with one very sharp curve and with a heavy grade, and is laid as an ordinary steam railroad track. The electricity is generated by a powerful dynamo machine, which is also one of Mr. Daft's own construction. No details have come to hand respecting this motor.

HALL'S "RELIABLE" FRICTION CLUTCH.

IN the ELECTRICAL REVIEW for October 14th, 1882, we illustrated and described Addyman's friction clutch, which was used with very satisfactory results on the electrically-propelled launch *Electricity*, which we had previously noticed. Addyman's apparatus seems to have met with general approval, and we believe extensive use has been made of it. In the Royal Aquarium Electrical Exhibition is to be seen the invention of Mr. Hall, which we think worthy of bringing before the notice of our readers. The clutch will be at once understood by referring to the figures and the following description:—The drawings represent the



inner surface or sheave of the clutch, A, which is turned true in the lathe, the diameter and breadth being calculated according to the maximum driving-power required. The elastic friction straps, H (two are used), are originally cast in a ring of tough cast-iron, and turned also true on face and edge, but of a larger diameter than the inner surface of the sheave, A. They are also thicker at the top and bottom and gradually taper down to the centre of the ring upon each side, where they are divided and a piece removed, so that when in position the said straps nearly touch at the sides, but are considerably away from the sheave at the top and bottom. Two stamped wrought-iron stirrup-shaped toggles, G, are united to the strap by a pin at one end, whilst the other spans the sliding block D, and is secured thereto by steel studs and a cap, A, enclosing the end of the said toggles. The sliding block is keyed to the driving shaft, C, and the sheave (to which motion is to be conveyed, may be a pulley or have a pinion or other driving gear at the back), B, runs loosely upon the said shaft until the sliding block is forced into it by a lever or screw, or other suitable appliance, when the outer surfaces of the straps come in contact with the sheave first, and as the block advances, bending the said straps to the curve of the sheave, every additional inch brought into play increases its hold until the whole surface is in contact, and by continuing the pressure, which acts all over alike, any driving power may be secured up to the strength of the parts employed.

This is the manner in which Mr. Hall effects a perfect and complete frictional contact between the sheave and the driver or driven shafts as the case may be. It is claimed by the inventor that in no other clutch is the contact so uniform, so perfect, and yet so sensitive to the variation of resistances as in this. If permanent contact is required, this can be accomplished by forcing home tight the elastic straps against the driving sheave by the screw and lever in conjunction with the toggles, whilst by a more moderate application of power, the frictional contact may be so nicely regulated that any additional resistance will be noticeable in the clutch. The inner surfaces may be lubricated to avoid any cutting or abrasion of the same without detracting from its power or usefulness. It may be made slow or instantaneous in action by a quicker or slower method of operating; and where great driving power is required a slower and more powerful means of putting it into action is necessary. It will be found desirable to use this clutch in machines where much shifting of the belt upon the fast and loose pulleys occur. For crushing rollers, and especially bone mills, it is said to be a great improvement upon the friction sheaves hitherto used, as it can be tightened up or released without slackening the speed of the machine, and without danger to the attendant.

We have thought it desirable—as in the case of Addyman's clutch—to bring Mr. Hall's apparatus before electrical engineers, there being many perhaps who do not get the opportunity of perusing journals devoted specially to mechanical engineering, and in the pages of which such inventions are more or less certain to appear as a matter of course.

I. THE TRANSMISSION OF POWER BY ELECTRICITY.

II. THE PORTRUSH ELECTRICAL RAILWAY.

By ALEXANDER SIEMENS and EDWARD HOPKINSON, D.Sc.*

I. NEARLY two years ago I addressed the Society on the subject of "Electric Railways and the Transmission of Power by Electricity." I now venture again to bring the subject before you, in conjunction with Mr. E. Hopkinson, in order to show the advance which has been made in the interval in actual applications, and to develop the theory of the subject more completely than was then possible. At the time of reading my former paper, there existed only one electrical railway, viz., the Lichterfelde line, near Berlin, and even this had but a short time previously been opened for traffic. Since then Messrs. Siemens and Halske have constructed, in addition to their pioneer undertaking at Lichterfelde, a line, 1½ miles long, from Charlottenburg to the Spandauer Bock, and a short line, worked only in the summer, in Kostverloren Park, near Amsterdam. They have also applied the system to a railway in the mines at Zankerode, in Saxony. At the International Electrical Exhibition in Paris, under the direction of Dr. Siemens, an electrical line was worked by Messrs. Siemens Frères, between the Palais de l'Industrie and the Place de la Concorde, which carried an average of over 13,000 passengers per week; and more recently, in the North of Ireland, the towns of Portrush and Bushmills have been connected by an electrical railway, six miles long, which will presently be described in detail.

It is unnecessary to refer further to the Lichterfelde line, as the details of its construction were given in my previous paper; suffice it to say, that for over two years it has worked continuously without hitch or accident of any kind.

The engine employed in the mines at Zankerode is shown in side view and in section on the diagram. The dynamo is placed with its axis lengthwise on the car, and works one pair of driving-wheels by means of bevel gear (shown in the diagram). The current is conveyed along the roof of the workings by means of an inverted T-iron rail on which a contact carriage freely slides, and connects with the engine by a flexible cable carried down the tube (shown in the diagram). The return current is taken by a similar cable and carriage to a second conductor, fixed by the side of the first. It is obvious that for mines the simpler method of using the rails themselves for conductors could not be advantageously employed, as they are in general very roughly laid and frequently shifted, which would make it difficult to maintain proper electrical conductivity. The engine is reversible, and the handles making and breaking the current, and the brake levers, are worked from either end, so that the driver always faces in the direction in which the engine is moving. The gauge of the line is 18 inches, the diameter of the wheels 13 inches, the extreme dimensions of the engine, length between buffers 8 feet, width 2 ft. 7 in., and its weight 1½ tons. It can develop sufficient power to draw a load of 8 tons, at the rate of 7½ miles per hour. Without going further into details, these figures will be sufficient to show how powerful an engine it is for its bulk and weight, and its adaptability for the special purpose for which it was constructed.

Leaving for the present the subject of railways, I will now show two examples of electrical transmission of power, as illustrations of the diversity of its possible applications, and then describe the electrical lift, and use it to illustrate the general theory of the subject. First, there is here an ordinary centrifugal pump, drawing water from the tank below, forcing it through the tube, and returning it again to the tank. The pump is worked by a strap from the Siemens machine, used as a motor, and the current is obtained from a somewhat larger machine, which is ordinarily used for lighting this room, but which, for the present, has been taken for the purpose of the experiment. Such a pump, coupled direct to its dynamo machine and mounted on wheels, would make an excellent fire-engine, as it is very easily handled and can be started at a moment's notice by sending a current through it. At some future time, when electric mains run along our streets by the side of the water mains, there will be no difficulty in obtaining the necessary currents from "electricity" plugs placed alongside the fire hydrants. At present, it would be necessary to transport secondary batteries with the electrical fire-engine, but even with this drawback the great advantage would be obtained of having the full power of the pump immediately ready for use, and every minute gained is of importance.

A further advantage lies in the possibility of connecting the water-main direct to the pump, as the pressure of the main would thus be utilised and no water wasted. Now, let the pump be disconnected, and replaced by the very small motor working the sewing-machine. It is important to observe that the same generator is used in both cases, and that neither its speed, nor any other of its conditions have been altered, excepting only the pull on the driving-strap; but that, in the case of the pump, probably about 5-horse-power of useful work was being done, while in the case of the sewing-machine perhaps one-fiftieth of a horse-power. Now, without stopping the

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sewing-machine, the whole of the 40 Edison incandescent lamps required for lighting this room shall be connected with the generator. The sewing-machine still performs its one-fiftieth of a horse-power of work, while from the same generator and the same leading wires, about 5 horse-power are employed in lighting the room.

These illustrations will be sufficient to show, in the first place, that when once we have electrical mains of sufficient capacity carried from central stations to our houses, how simple a matter it will be to combine lighting with domestic operations, and even the larger operations required for purposes of trade; and, in the second place, that each motor of a series placed in parallel circuit performs the work required of it independently of all the others, and independently of the generating machine, provided only that the generator is capable of producing the power it is called upon to furnish.

This second point I will now show to you in a different form, and explain it mathematically. The diagram represents an electrical hoist, designed by Dr. John Hopkinson, and made by Messrs. Siemens Bros. The electrical part consists of an ordinary D_5 series dynamo, fitted with reversing gear (shown on the diagram) for reversing the direction of the current and the lead of the brushes, and, consequently the direction of rotation of the machine. In the mean position, both pairs of brushes are lifted from the commutator, allowing no current to pass. The dynamo runs at a high velocity, and consequently is connected by a spur gear to the lifting axle, to diminish the speed of lift and increase the leverage. On this axle a chain pulley is fixed by means of a special friction clutch, which need not now be explained. The clutch automatically holds the weight attached to the chain, as soon as the dynamo is stopped. Having coupled up the leads to the terminals of the machine, and hung a weight of one hundredweight on the chain, start the dynamo, measure roughly the speed of lift, and by means of the electro-dynamometer the current passing through the dynamo—

Weight.	Speed.	Current.
1 cwt.	4 feet per sec.	9 amperes.

Now, let the attached weight be doubled without altering any other conditions, and again measure the speed and current—

Weight.	Speed.	Current.
2 cwt.	2·5 feet per sec.	13 ampères.

You will observe, as you would expect, that with the heavier weight the speed has diminished and the current increased.

Secondly, I will again put on the weight I had in the first experiment, but insert a resistance of $2\frac{1}{2}$ ohms in the leading wire. Again measuring the current and the speed, we have—

Weight.	Speed.	Current.
1 cwt.	2 feet per sec.	9 ampères.

You will see that the current is exactly the same as before, while the speed has diminished. Taking, again, the double weight, and leaving the resistance inserted, we have—

Weight.	Speed.	Current.
2 cwt.	1 foot per sec.	13 ampères.

Again the same current as we had before with the double weight, but a diminished speed. From these experiments it is clear that for a given load the current remains constant, whatever the speed may be, and that the speed principally depends upon the resistance through which the current passes.

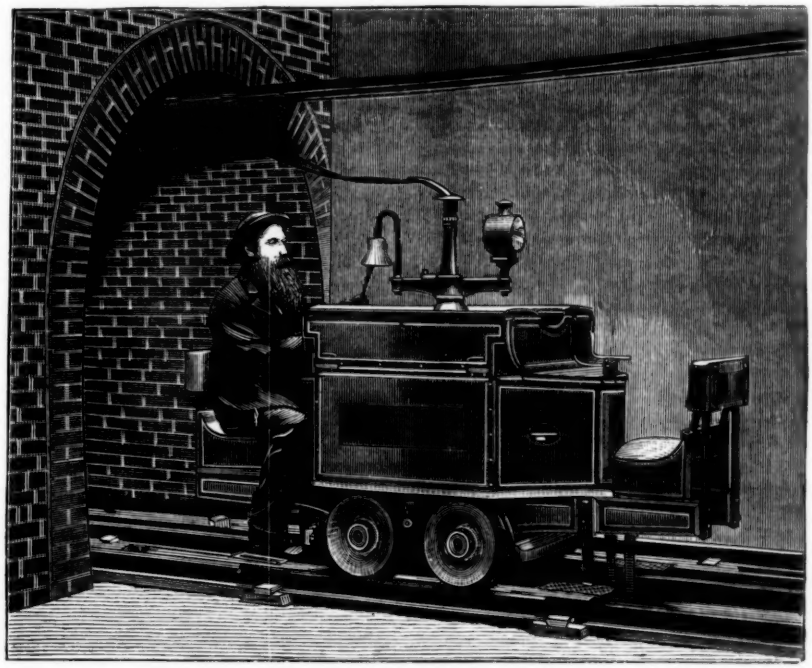
On the diagram is shown the results of a series of experiments with the same hoist, made at the works of Messrs. Siemens Bros., under conditions which allowed of greater accuracy than is possible here to-night.

Resistance inserted in circuit, in ohms.	Work done. Load 56 lbs. 7·3 ampères.		Work done. Load 1 cwt. 9·2 ampères		Work done. Load 2 cwt. 12·9 ampères.	
	Speed in feet, per minute.	Foot-lbs., per minute.	Speed in feet, per minute.	Foot-lbs., per minute.	Speed in feet per minute.	Foot-lbs., per minute.
·3	212	11,870	180	20,160	130	29,120
1·3	190	10,640	164	18,370	112·5	25,200
2·2	169	9,480	150	16,800	90	20,160
3·2	157	8,790	130	14,560	71	15,900
3·7	150	8,400	125	14,000	59·5	13,330
4·8	141	7,850	111	12,430	36·5	8,180
5·7	130	7,280	90	10,080	19	4,260
6·3	129	7,200	84	9,410	—	—
8·3	98	5,480	56	6,270	—	—
9·7	80	4,230	27·3	3,060	—	—
11·6	47	2,628	—	—	—	—
12·7	35	1,960	—	—	—	—
14	18	1,008	—	—	—	—

Three conclusions are to be drawn, which are the fundamental principles of the theory of the electrical transmission of power.

I. The motor, as a machine, is entirely independent of the generator, and must be designed for the particular work it has to do without reference to the generator.

II. The current depends upon the load on the motor, and upon no other thing whatever.



Engine Employed in the Mines at Zankerode.

III. The speed depends upon the E.M.F. of the generator, and the total resistance in the circuit of the machines. If the mains which supply the current to the motor be maintained at a constant potential, and the motor be separately excited, or have permanent magnets, the speed is proportional to the potential of the main, less the loss of potential due to the resistance of the armature.

As a practical corollary, the generator must be designed to give the current required of it by the motor, and E.M.F. sufficient after allowing for fall of potential through the resistance of the mains, to give the requisite speed. Keeping these points in view, it is easy to design a combination of machines for performing any particular kind of work, and to calculate exactly the efficiency of the combination, and to account for the various losses that occur.

Now let us put these considerations in a mathematical form. The first problem is:—Given a mean with a constant E.M.F. denoted by E, to construct a dynamo machine, drawing its current from the main, to work with a given load, L, and at a given number of revolutions, n, per minute. Let us make use of the characteristic curves, used by Dr. J. Hopkinson, Dr. Frölich, M. Marcel Deprez, and others.

Take ox, oy as an axes of co-ordinates, along oy, cut off o M, representing the E.M.F. of the main in volts. Now, the makers of each type of dynamo machine know approximately the percentage of energy their machines absorb in producing the necessary magnetic field. Take a point, N, in o M, such that the ratio,

$$\frac{\text{o N}}{\text{o M}},$$

is equal to this percentage. Again, it is known that a dynamo is not an absolutely perfect machine, but that a certain amount of energy is wasted in the friction of the bearings and of the brushes

against the commutator, and also in induced currents in the core of the armature. Take O R, such that

$$\frac{O\,R}{O\,N}$$

represents the efficiency of the machine. This, in the case of the Siemens machine, is at least 90 per cent. From ox cut off O H, such that the rectangle, O H R′ R, represents the power required from the motor expressed in watts. Then O H is the current passing through the motor, measured in ampères, and H P is the inverse E.M.F. The proper motor, therefore, is that dynamo which, when running at the given number of revolutions, n, per minute, has a characteristic curve passing through the point, P. The total efficiency is evidently the ratio of the rectangle, O H R′ R, to the rectangles, O H M′ M, which is equal to

$$\frac{H\,R'}{H\,M'};$$

the electrical efficiency is

$$\frac{H\,P}{H\,M} = \frac{E'}{E},$$

the ratio of the inverse E.M.F. of the motor to the E.M.F. of the main. The energy spent in magnetisation is measured by P N M M′; and the tangent of the angle, P N M′, represents the resistance of the armature and magnets.

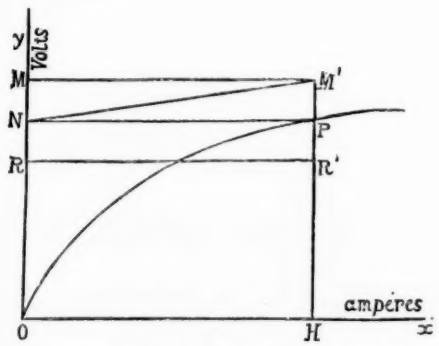


FIG. 1.

The second problem is;—Given a motor requiring a certain current and E.M.F. for the work it has to do, to construct a suitable generator, the distance between the machines being represented by an electrical resistance, R, measured in ohms. Let O P P′ (fig. 2) be the characteristic curve of the motor, when running at the required speed; P H the E.M.F. in volts, and O H the current in ampères. Let

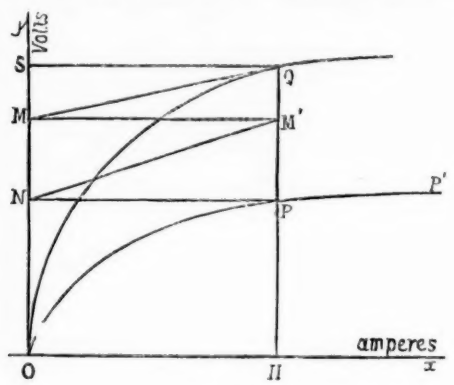


FIG. 2.

R′ be the sum of the resistances of the motor and R the conductor. Draw P N perpendicular to oy, and make the angle P N M′ having its tangent equal to R′; then M′ H represents the difference or potential between the terminals of the generator. Produce H M′ to Q, so that

$$\frac{Q\,M'}{Q\,H}$$

is the ratio of the energy expended in producing the magnetic field to the total energy of the machine; then the generator is that dynamo which, when running at its proper speed, has a characteristic curve passing through the point Q.

The electrical efficiency of the combination is the ratio

$$\frac{P\,H}{Q\,H'}$$

i.e., the ratio of the E.M.F. of the generator, which, if the machines are similar, is equal to the ratio of their speeds. The energy converted into heat in the wires of the machine, and in the conductor, is N P Q S; and the total efficiency of the combination is the ratio of the electromotive forces, multiplied by the product of the efficiencies of the two machines, considered separately. The conductor connecting the two machines has been considered to be perfectly insulated. Of course this is not practically attained, but I will not now consider the point particularly, as it has very recently been discussed from an analytical point of view, by Dr. O. J. Lodge.

The diagrams might be used for proving many other points of interest in connection with the theory of transmission of power, especially Jacobi's law of maximum effect; but I think it will probably be of more advantage to leave the rest of the time at our disposal to Dr. Edward Hopkinson, to describe the Portrush Railway, the electrical part of the work of which he has had in charge, under the direction of Dr. Siemens, particularly as it will illustrate how these principles have been carried out in practice, and the results obtained therefrom.

(To be continued.)

ELECTRICAL DISTRIBUTION.

(Messrs. Gaulard & Gibbs' System.)

IN a preliminary notice of the Royal Aquarium Electrical Exhibition we briefly referred to the apparatus of Messrs. Gaulard & Gibbs, based upon the principle of the Rhumkorff coil, and intended for the distribution of electrical energy.

The decision of the committee officially appointed to determine the maximum electromotive force of currents connecting consumers with central stations has not only disturbed the dream of electricians who had thought to see natural forces utilised by means of electricity, but the several electric lighting companies find in that decision a new difficulty in the way of supplying electricity to the districts for which they have applied for Licences or Provisional Orders. Nevertheless, the committee seems justified in its decision by the frequent risks to which consumers would be exposed were their lighting or storing apparatus on a circuit traversed by a current of too high tension—for these apparatus, as circumstances or the convenience of consumers might require, would be liable to be placed in or taken out of the circuit.

Doubtless a special interest attaches to the system of electrical distribution by the secondary generators of Messrs. Gaulard & Gibbs, for by this system high-tension currents are utilised, and that without danger of any kind, so it is said.

The secondary generators are shown in operation every day at the Royal Westminster Aquarium.

The principle forming the basis of this system is thus described by the inventors: When a current in movement, in a metallically closed circuit, traverses a solenoid placed on the centre of a bobbin of insulated copper wire it determines in the circuit of this bobbin an induced current, whose nature depends only on the construction of the bobbin, the quantity being proportionate to the quantity of the primary current. The quantity of the primary current will not be diminished if the tension is sufficient to overcome the resistance created by the secondary current, this resistance being, of course, proportionate to the electromotive force developed on the secondary circuit. It follows that an indefinite number of secondary generators may be placed upon the primary circuit, provided the tension of the current traversing this primary circuit be sufficient to overcome the sum of the resistances set up by the electromotive force developed by the secondary generators.

Our readers will understand that it is an induction coil pure and simple which forms the subject of the above paragraph.

The secondary generators of Messrs. Gaulard & Gibbs are constructed as follows, and are thus described:

On a cardboard or wooden cylinder about 50 centimetres high is rolled in parallel spirals and in rows one above the other, a cable composed of a central copper wire of 4 millimetres diameter (No. 8), having a high insulation of paraffined cotton. Parallel to the axis of this wire, and completely surrounding it, are placed six cables or strands of twelve wires each individually insulated by paraffined cotton.

The first wire of 4 millimetres forming the inductor is traversed by the primary current from a dynamo-electric machine, and the 6 cables of 12 wires each forming the induced system have their extremities united to a commutator so as to allow of their being grouped in quantity or in tension. This commutator is placed in the centre

of four columns thus disposed, the extremities of whose secondary wires are arranged so as to be brought to eight terminals placed upon the upper platform of the apparatus, and from which can be taken at will the individual currents generated by each column or of two or more columns grouped in tension or in quantity. On the lower platform supporting the columns the commutator there placed enables the primary current to be passed by 1, 2, 3, or 4 columns as desired.

Lastly, in the hollow cylinder in the centre of the columns are soft iron bars which are raised and lowered at will, thus allowing the gradual regulation of the currents developed in each of the bobbins. Two of these instruments are shown at the Aquarium; they are placed one after the other on a closed circuit traversed by a current of 13 ampères furnished by an alternating current Siemens machine.

One of these secondary generators produces a current of 40 ampères lighting 26 incandescent lamps distributed over the court by means of a chandelier and brackets, three of these lamps are in a small aquarium. The other secondary generator from one column lights 5 Swan lamps, two of the other columns grouped in tension light a Jablochkoff candle, the fourth column is employed to turn a motor. The soft iron cores of which we have spoken enable the light of the lamps to be graduated without the smallest shock from 0 to the highest intensity.

In the drawings, fig. 1 is a perspective view of the apparatus working at the Aquarium, reproduced from *Engineering*, and figs. 2 and 3 show respectively a longitudinal section of one of the coils and the diagram of an installation of dynamo-electric machine and secondary generators.

It will be well to mention here that the description given above relates to an improved form of induction coil which is not yet completed. The coils at present in use have each three layers of primary wire, and the secondary is made up into four sections, as shown in the drawings.

The motor traversed by the secondary current of one column of the generator (we would here remark that this current is alternating) takes a movement synchronic with the rapidity of the alternations, whatever may be the quantity of the current which traverses it.

FIG. 1.

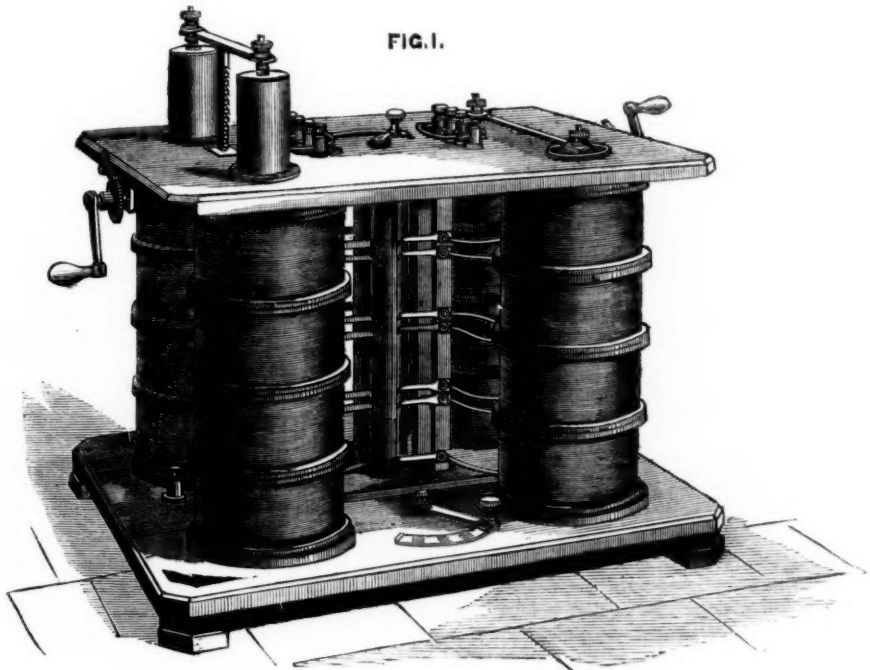


FIG. 2.

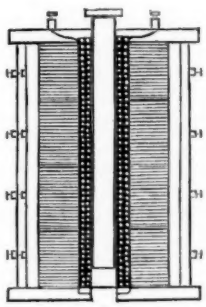
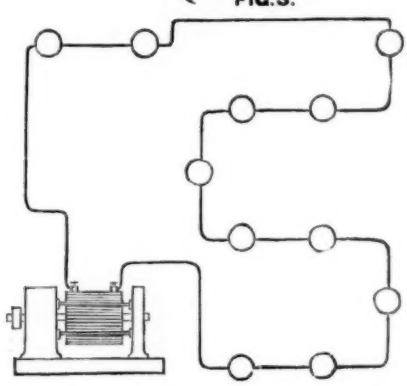


FIG. 3.



To resume, by means of a single wire of small diameter, traversed by an alternating current of small quantity, the inventors claim to be able to supply from house to house by means of their secondary generators, currents of varying potential, as may be required by consumers, absolutely independent of one another, and consequently applicable to every form of lamp and to every kind of use.

They show also, by means of a Spottiswoode form of induction coil, that when the circuit traversed by the secondary current is metallically closed it may be touched without any effect whatever being produced on the person so touching.

As this experiment simply consists in placing the discharge-points in contact with one another, it proves nothing in relation to the Gaulard & Gibbs apparatus, because in

their system the secondary circuit is not closed metallically but through arc or incandescent lamps, as the case may be.

Having thus given, in the words of Messrs. Gaulard and Gibbs, a description of the apparatus now to be seen at the Royal Aquarium, we will refer back to similar ideas emanating from prior inventors.

One of our contemporaries, in speaking of the secondary generators which form the subject of this article, says that M. Jablochkoff patented in 1877 the combined use of a generator, induction coils, and lamps. The coils were placed in the main circuit, the current of which was interrupted by a make-and-break, and the lamps were situated in series in each of the secondary circuits. What measure of success he obtained we do not know, but we believe that the system was actually tried in this country. M. de Méritens, and also Mr. Bright, provisionally protected similar schemes, but neither seemed to think them worth prosecuting.

To this statement Messrs. Gaulard & Gibbs said in reply that the above-named gentlemen had in effect no other end

FIG. 4.

in view than to employ known phenomena, such as those produced by the Rhumkorff coil for the production of special effects by the aid of lamps specially constructed, and they certainly would not have stopped short where they did if they had believed it possible to transform the Rhumkorff coil in such a manner as to be able to produce electrical currents applicable to every requirement, and especially in the case of M. Jablochkoff, if he could have produced a current suitable for lighting his candle.

In the ELECTRICAL REVIEW for April 15th, 1879, appeared two short articles bearing so directly upon the invention of Messrs. Gaulard & Gibbs that we feel sure that a reproduction of these will be found most interesting at the present moment. The first notice is upon an invention of the late J. B. Fuller, of Brooklyn, N.Y., which consisted of an improved induction apparatus for lighting by electricity.

It is shown in perspective by fig. 4 and in section by fig. 5. The inventor's aim in the construction of this apparatus was to operate along the main electric circuit a large number of small lights, each being placed in a local circuit, whose currents are induced by the currents of the main circuit. Two magnet cores are arranged parallel with each other, and connected magnetically at the ends, as shown in fig. 5. Around the centre of each of these cores is a soft iron head, and at a short distance from each side of this is a head of insulating material. The outer ends of the cores are coiled with insulated copper wire, and so connected together and to the electric generator as to produce, when in action, two consequent opposite magnetic poles, at N and S. A, B, C, D, and E, represent the connections of these coils. Between the iron heads and these coils are wound smaller coils of insulated wire, the fineness of which depends upon the tension of the current required.

There is an iron arm hinged to one of the iron heads, so as to swing over upon the seat connecting magnetically the poles, N and S, as shown in fig. 4. Now, if electric currents be sent through the main circuit, flowing around the large coils, and rapidly changing, in alternately opposite directions, the magnet cores will as rapidly change polarity, and these changes will induce in the small coils electric currents of greater or less tension, according to the fineness of the wire composing the small coils.

In the circuit of each of the small coils may be placed a lamp, F, of minimum illuminating capacity. Two small coils may be connected together, *parallel* or *in series*, for producing a light of medium capacity, or four small coils may be connected for producing one light of maximum capacity, as shown in fig. 5.

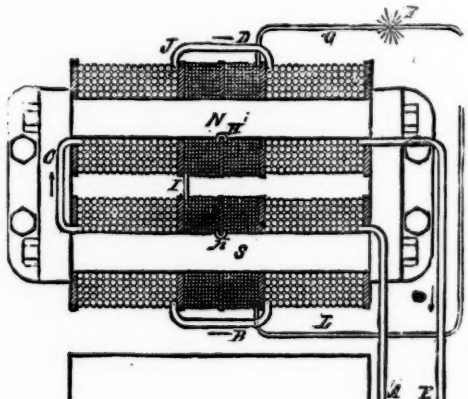


FIG. 5.

These connections for producing any changes in the circuits are made by means of ordinary switches, plugs, or keys. The arm which extends across the face of the coil in fig. 4 acts as a governor of the light, by strengthening or weakening the magnetic poles, and thereby varying the strength of the current.

Any number of such apparatus which the electromotive force of the generator will supply may be arranged along the line of a conductor, the large coils being included in the circuit, and, by means of a switch in the local circuits, each or any lamp may be lighted or extinguished independently from the others.

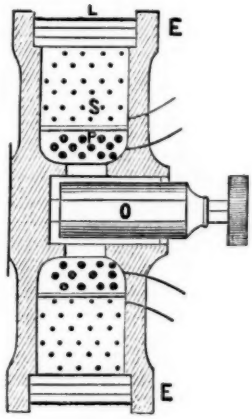
The second article deals with an induction apparatus for reversed currents by Professors Thomson and Houston, of America, and the apparatus was devised by them for the purpose of obtaining induced reversed currents for use in electric illumination.

The method of operation is as follows:—A reversed primary current is caused to induce in reversed secondary coils provided therefor. These secondary currents are caused to give vibrations to carbon electrodes, and thereby at the same time produce a partial arc between them. (Messrs. Houston and Thomson used a vibrating lamp, which had previously been described.) With sufficient strength of primary current, a considerable number of secondary currents are obtained, each of which is able to operate one of the vibrating lamps.

The use of a vibrating lamp admits of a wide range in the size of the carbons employed. When a light of very

moderate intensity is desired, the carbons are made of very small size, and are placed in a closed glass vessel for protection from the atmosphere. To moderate the brilliancy, opalescent glass is used.

To obtain the highest efficiency of inductive action from a set of primary coils, the following form of induction of coil was devised: the primary coil P, surrounding the



core O, is provided with a secondary coil, S, adjacent to it. The ends, E, E, of the bobbin, are made of discs of iron concentric with the core, O, and are slit from centre to circumference. The outer extremities of these discs are connected by wires or sheets of iron, L, to one another, forming, in this manner, an induction coil encased in iron, or one whose core has its north and south extremities magnetically connected. The strength of the current developed in the secondary coil is greatest when the core, O, which is *movable*, is inserted so that both of its extremities are in contact with E, E. By *withdrawing* this core, the currents in the secondary coil may be *weakened* to almost any desired extent. This coil is adapted to the use of primary currents whose direction is constantly changing. All the wire being completely surrounded by iron whose direction of magnetic polarisation is rapidly changed, the highest inductive effect is thereby produced in the secondary coil.

The variations in the intensity of the induced currents will, of course, be followed by variations in the intensity of the light emitted by the lamp. The movement of the core may, therefore, be made to increase or decrease the intensity of the light.

Our readers can now judge for themselves whether Messrs. Gaulard & Gibbs have distanced in any great degree by the special construction of their apparatus and the greater facilities which exist at the present day, the proposals made by Fuller and Messrs. Houston & Thomson four years ago.

It is well known that Mr. Edison and his supporters have up to the present advocated the direct supply of electricity from the dynamo-electric machines, as being the most practical and economical system that can be adopted, and were it not for the probability of an occasional breakdown, the majority of electrical engineers would doubtless agree with that eminent American.

Secondary or storage batteries have numerous and enthusiastic adherents who hold that a reliable accumulator is the only thing wanted to make electric lighting absolutely to be depended upon. No doubt the secondary generators of Messrs. Gaulard & Gibbs will attract a number of admirers, and although these apparatus can hardly be compared with accumulators, yet, as they are both opposed to the direct supply system, they are thus far similar. The secondary generators of Messrs. Gaulard & Gibbs are necessarily dependent upon alternating-current machines, and should any accident happen to the machine or leading wires, their apparatus is rendered useless. On the other hand, the chief use of secondary batteries is to obviate any breakdown in the generating machinery. Continuous-current machines only can be used to charge them, but as these are more likely to be in demand than dynamos with alternating currents this cannot be looked upon as a drawback.

Messrs. Gaulard & Gibbs appear to think that although the decision arrived at in the Electric Lighting Act and mentioned at the commencement of our article, as to the regulations affecting the maximum electromotive force, &c., is reasonable in the case of circuits liable to be open or closed at several points, whether in the main circuit or in derivation, it is certainly not so where a circuit would remain constantly metallically closed with the generating dynamo machine, for in this latter case currents of the highest potential could exercise no action whatever upon the human body.

They do not, however, mention the possibility of danger from the secondary coils of their apparatus which might occur through careless or incautious handling when any change of connection is rendered desirable. What loss occurs in the transformation from a direct to an induced supply of electricity in these secondary generators we are not yet in a position to state, but no doubt tests will soon be made by competent authorities, and until such time arrives it is not advisable to express a decided opinion upon the apparatus we have described. Perhaps some of our readers may be inclined, as in the case of Ball's dynamo-electric machine recently described by us, to favour us with their views on Messrs. Gaulard & Gibbs' invention, or with any results of former experiments in this direction which may be known to them.

In a future number we shall ourselves hope to return to this matter, as the new coils already referred to are shortly expected to be ready, and from these the inventors hope to obtain superior results to those given by their present instruments.

THE ELECTRIC LIGHT COMPANIES OF AMERICA.

In the following *résumé* of the market for electric light shares (says an American Exchange) the figures given ar eof sales that have been made through brokers; but higher prices may have been obtained at private sales.

The Edison Electric Light Company, the parent company and pioneer in the field, was originally organised with a capital of $300,000. This was increased to $460,000, and then to $720,000. The company owns about 51 per cent. of the stock of the Edison Illuminating Company, which was organised to use the Edison inventions in New York, and of the stock of the Edison Company for Isolated Lighting. The value of these holdings is taken into consideration in estimating the value of the shares of the parent company. When its capital was $300,000 its $100 shares sold as high as $3,700. The stock is now selling at the lowest figure it has touched since it came upon the market, namely, $250 a share. The price has twice been affected by the increase of the company's capital, as the increase in capital has been offered to the stockholders at par. At the present market value of the shares of the Edison Illuminating and of the Edison Isolated companies it is estimated that the stock of the parent company is worth about $150 a share, merely as representing the interest of each share in the aggregate market value of the stocks held by the company.

The capital of the Edison Illuminating Company is $1,000,000, and the par value of its shares is $100. Fifty-one per cent. of its stock was given to the parent company for the Edison patents, which it is entitled to use exclusively in New York City. The company proposes to light the city by districts. Its stock has sold as high as $125 a share and as low as $30. The former price was reached before the company had got much of its plant, and the latter a few months ago.

The Edison Company for Isolated Lighting was organised with a capital of $500,000, which was subsequently increased to $1,000,000. The par value of the shares is $100. The object of the company is to furnish light by the Edison system, and patents to single buildings or establishments. Fifty-one per cent. of its stock is owned by the parent company, having been issued to it for the patents and privileges. When the capital of the company was $500,000 its stock first sold up to $240 a share, and then as low as $175 a share. The stock now brings $155 per share. This is the only Edison company that has paid a dividend. One of 10

per cent. out of the operations of the last year has recently been declared. Though the parent company has never paid a dividend large profits have accrued to its stockholders by two awards of new stock at par at times when the premium was very great.

The Edison Electric Light Company of Europe was organised about two years ago, simultaneously with the other offshoots of the original company. Its capital is $2,000,000, and the par value of its shares $100. It has a monopoly of the Edison system in Europe. Its stock sold soon after it came on the market at $165 a share, and has declined to $40.

The capital of the United States Electric Lighting Company is $1,500,000. Its shares, of the par value of $100 each, sold about three years ago at $300 per share. The last reported sale was at $125, and at present $130 is bid and $150 is asked. The company has just declared its first dividend. It is five per cent. in cash, but whether it is to be considered as an annual, a semi-annual, or a quarterly dividend cannot be learned.

The patents of the United States Company are used extensively in New York by the United States Illuminating Company, which has a capital of $1,000,000, only one-half of which has been issued. The transactions in its stock have not been large. The last was at $103 per share.

The Brush Electric Company of Cleveland sustains practically the same relation as the Edison to several minor companies. It has a capital of $3,000,000, in $100 shares. The stock sold recently at $110, and it is said that it can be bought at that price now. It has never sold below its par value. The company has paid quarterly dividends of 2 per cent. for three years.

The Brush Illuminating Company of New York uses the Brush inventions and systems in that city. It furnishes, it is said, over 1,000 lights nightly in the up-town districts, which it supplies at an average price of 80 cents a light per night. It is reported that the company will earn $100,000 net this year. The capital is $1,000,000, and the $100 shares have sold as high as $125, and about three months ago had dropped to $70. The current quotation is $100 bid, and $110 asked.

The Brush Illuminating Company of New York owns most of the stock of the Brush Electric Light Company of New England, which uses the Brush system throughout the Eastern States. This stock is not dealt in, but is supposed to be worth about $500 or more a share. The company has just declared an extra cash dividend of 30 per cent., making a total of 58 per cent. that it has paid within a year.

The Fuller Electrical Company manufactures electrical machines. It has a capital of $870,000, of which $300,000 is common stock and $570,000 preferred. The par value of both classes is $100. The common stock has sold from $32 to $22 a share, and the preferred from $61 to $75 a share. Present quotations are $30 bid for the common, offered at $32, and $75 bid and $100 asked for the preferred.

The American Electric Light Company has been distinguished chiefly for the counter charge of fraud that some of its officers exchanged a few months ago. The company has a capital of $500,000 in $50 shares. Some of these shares have sold at $35. They are now offered at $4.75.

The Brush-Swan Electric Light Company is the last organised enterprise of this class. It combines all the Brush and Swan inventions, and uses electricity generated by the Brush process in the Swan incandescent lamp. The capital of the company is $600,000, and the par value of its shares is $100. Sales have been made at $150 a share, and it is now quoted at $105, and $150 asked.

For the common protection of their patents, all of the leading electric light companies formed, some two years ago, the Gramme Electrical Company. The shareholders are the American Electric Company of New Britain, Conn.; the Brush Electric Company, the Edison Electric Light Company, the Fuller Electrical Company, the Jablochkoff Electric Lighting Company, the United States Electric Lighting Company, and the Weston Electric Light Company. The stock has no marketable value.

While the prices that now prevail for the shares of most of the electric light companies are the lowest that have ruled, it will be observed that there has been a considerable recovery in the case of those companies which have demonstrated their ability to make returns upon the money invested in them. These are few in number. So far as speculation is concerned, however, the inquiry for electric light shares is, according to the brokers, increasing, and the volume of the transactions larger as compared with three or four months ago, when trading in them was at a standstill. This, doubtless, is largely due to the first dividends recently declared by two or three of the companies.

NOTE ON THE INFLUENCE OF SURFACE-CONDENSED GAS UPON THE ACTION OF THE MICROPHONE.*

By I. PROBERT and ALFRED W. SOWARD.

ONE of the theories advanced to account for the action of the microphone states that the layer of air between the microphonic surfaces acts as an ordinary resistance, that the effect of sonorous vibrations is to cause the carbons to approach and to recede from one another, and so to alter the thickness, and consequently the resistance, of the interposed layer. This variation of resistance produces the variation of current essential for the reproduction of sound.

There is in physics a phenomenon known as heterogeneous adhesion, one phase of which is the surface condensation of gases. A study of this phenomenon shows that every surface exposed to a gas is coated with a condensed layer of that gas. The more readily the gas is liquefiable by pressure the greater is the quantity condensed, and in the case of the very readily liquefiable gases the exposed surface is actually coated with a layer of liquid.

Our atmosphere, as is well known, consists mainly of nitrogen, oxygen, carbon dioxide, and water vapour. Careful experiments with charcoal (a substance which, owing to its porous nature, possesses a very large surface relatively to its mass) show that the co-efficients of surface condensation of these gases (that of hydrogen being taken as unity) are 3·5, 4, 15, and 80 respectively. These figures multiplied by the figures representing the proportions in which the gases exist in the air, viz., 79, 21, ·03, and (say) 1·5 give the proportions in which the substances exist in the condensed layer. They are: Nitrogen, 276·5; oxygen, 84; carbon dioxide, ·12; and water vapour, 120. Of those four gases the first two, oxygen and nitrogen, would be condensed without liquefaction, and the effect of this condensation would be to slightly reduce the electrical conductivity of the layer, for it is known that the conductivity of a gas is decreased by condensation; the carbon dioxide would probably be liquefied, and the effect of its liquefaction would be (slightly on account of the small quantity acting) to increase the conductivity; the water vapour would certainly be liquefied, and the effect of its liquefaction would be to very considerably increase the electrical conductivity of the layer. The effect then of this phenomenon of surface condensation is to coat the microphone surfaces with a layer of far better electrical conductivity than ordinary air.

In order to test the influence of this layer of condensed air upon the action of the microphone we have lately made some experiments with the instrument in different gases. The gases used were, hydrogen, carbon dioxide, wet air, and dry air; and our method of experimentation was as follows:

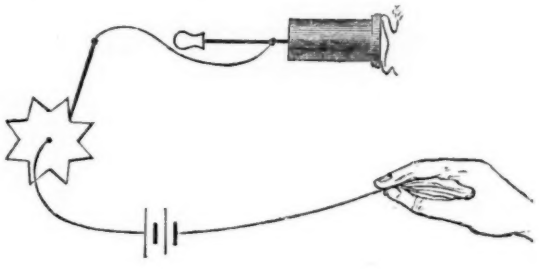
A microphone of a well-known pattern, consisting of a glass tube containing cylindrical carbon blocks and having many contact surfaces, was attached to the inside of a clock case, and placed in circuit with a Hughes' audiometer, a Morse key, and three Leclanché cells. The carbon blocks of the microphone were pressed well together so as to avoid as far as possible alteration of contact due to chance vibrations. A current of air, dried by passage over pumice stone soaked in strong sulphuric acid and then over pentoxide of phosphorus, was urged through the microphone for half an hour. The resistance of the microphone was then measured, and the point of the audiometer scale determined at which the beating of the clock became inaudible in the telephones.

* Read before the Society of Telegraph Engineers and of Electricians on Thursday, 12th April, 1883.

A current of similarly dried hydrogen was then passed through the microphone for half an hour, and the resistance again measured and the point of silence determined in the audiometer. The experiment was next repeated with carbon dioxide, the dried gas being passed through the microphone for a similar period; and, finally, for fifteen minutes, a current of air was forced through water contained in a Woulffe's bottle (in order to load the air with water vapour) and then through the microphone. The resistances and points of silence in the audiometer were determined as before. Our results are expressed in the following table, and it may be noted that the scale of the audiometer was graduated from 0° in the centre to 100°.

Name of Gas.	Resistance of microphone in ohms.	Point on scale of audiometer at which silence was reached.
Wet air	386	51°
Carbon-dioxide	435	56°
Hydrogen	600	58°
Dry air	520	63°

It will be seen that the best result was obtained with wet air, which calculation shows should give a good conducting surface layer. Next in order is carbon-dioxide, which, in the liquid state, is a moderate conductor. Hydrogen comes next, as would be expected, for neither it nor dry air is reducible to the liquid state by ordinary surface condensation, and the best result is to be looked for from the less condensable of the two—that is, hydrogen. The resistance of the hydrogen-charged microphone is, however, anomalous.



In order to obtain our layers of condensed gas we considered it sufficient to pass a stream of the desired gas over the microphone for some time, because it is known that when a piece of carbon charged with one gas is placed in an atmosphere of another the two gases diffuse into one another with a result that the carbon remains charged with a mixture in the proportion indicated by multiplying their percentage volumes by their respective condensation co-efficient. In our experiments the quantity of gas passed through the microphone in any one experiment was vastly greater than the residual gas from previous experiments.

We did not attempt to rigorously exclude water in any of our experiments, for it has been shown that the last trace of water so obstinately clings to a surface that to perfectly dry a glass tube it must must be raised to the softening point and so kept for some hours while a stream of dry air is urged through it.

In these experiments with different gases there is a possible source of error which must not be overlooked. We have elsewhere shown (*Chemical News*, vol. xlvii., p. 157) that the resistance of a porous piece of carbon is not a constant for a given temperature, but varies with the chemical nature and with the density of the gas with which the pores of the carbon are filled. It follows from this that if a constant electromotive force be used, the current flowing and the sounds obtained will be altered by any alteration in the nature of the gas absorbed in the body of the microphone, irrespective of the contact surfaces. But the carbon used for our microphone had very little absorptive power, and its resistance was practically constant at contact temperature.

We think from these experiments it is fair to infer that the layer of condensed gas with which every microphone surface is covered is concerned to some extent in the regulation of microphonic action.

As bearing upon the effect of a layer of moisture, we may notice the following experiment:—

A common tin canister, joined through a rheotome to one pole of a four-cell Grove's battery, and held in the hand by an insulating handle, was pressed against the ear; a wire attached to the second pole of the battery was held against the tongue. Sounds were heard corresponding to the working of the rheotome, and a burning sensation was experienced at the ear, such as one might imagine would be produced by innumerable small electric discharges. Similar results were obtained with a ten-cell Daniell's battery (chamber pattern). The surface of the canister, which, having been exposed to the air, was coated, as all similarly exposed surfaces are, with an invisible layer of moisture, was then well wetted. The burning sensation became more marked, but the sounds of the make and break were no longer audible. We may add that a solid brass ball, whether wet or dry, gave no sounds in this experiment.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph Engineers and of Electricians.

An ordinary general meeting of this Society was held on Thursday, April 12th, Mr. Willoughby Smith, President, in the chair. The minutes of the last ordinary general meeting having been read and confirmed, and the list of new and proposed new members announced, a paper was read by Mr. Shelford Bidwell on "Microphonic Contacts." *

Loose contacts are proverbial for the uncertainty of their action, and it was to be expected that an investigation into their action would prove troublesome, and the results obtained by no means uniform. But by multiplying experiments, the element of uncertainty has been to a great extent removed, and several interesting facts seem to be clearly established. The arrangement adopted for nearly all the experiments consisted of a little balance, formed of a light steel rod, balanced on a knife-edge fixed at right angles to it. To one end of the rod was attached a split tube of thin copper for holding short rods of the different substances to be tested, which were held so as to press at right angles upon another rod held in a spring clamp. A scale-pan and a sliding counterpoise enabled different pressures to be exerted between the two microphonic surfaces. The object of the first experiments was to ascertain the effects of various pressures upon the resistance of two carbon rods, the measurements being made with a Wheatstone's bridge in the ordinary manner. The rods selected were electric light pencils of gas carbon, 6 mm. in diameter. In all, seventeen series of observations were thus made, the weights in the scale-pan varying from ·5 gramme to 100 grammes. The mean of three of these, the weights and corresponding resistances, plotted out so as to form a curve, showed clearly that the greatest variations occur when the pressure is small and the resistance comparatively high. Thus, between ·25 grammes and 5 grammes the resistance falls 5·1 ohms, while between 25 and 50 it only falls ·3 ohms. It soon became evident that the resistance of the carbon contact was largely dependent on the electromotive force or the strength of the current used, the resistance falling with increase in the current. Thus when the pressure was ·25 grammes the resistance with 1, 2, 3, or 4 cells was 11·10, 7·20, 4·70, and 3·55 ohms respectively.

The resistance of the carbon contacts varied greatly with the strength of the current when the pressure was small, and but very slightly when the pressure was great. It is clear, therefore, that the diminution of resistance which occurs when the pressure between carbon contacts is increased, is not under ordinary circumstances due solely to the increase of pressure; for the diminished resistance which results from the increased pressure causes an increase in the strength of the current, the effect of which is a still further fall in the resistance. Thus the total diminution of resistance is due only partly to increase of pressure, and partly also to increased strength of current. With small pressures the resistance is largely dependent on the strength

* Similar experiments by Mr. Bidwell were fully given in the Electrical Review for February 17.

of the current, but when the pressure is considerable the resistance with weak and strong currents is nearly the same.

A few experiments were made in order to ascertain whether the diminution of resistance under pressure was entirely of a temporary nature, or whether it continued in any degree after the pressure had been removed. A weight of 1 gramme being in the scale-pan, the resistance of the contact was measured with the Wheatstone's bridge and one Leclanché cell; the 5-gramme weight was then lowered into the pan, and a measurement made of the diminished resistance. The 5-gramme weight was again gently raised, and the resistance with a single gramme once more measured. In every case it was found to have returned almost exactly to its original value. The experiment was repeated with a resistance of 300 ohms between the battery and the bridge, that the current might be smaller. The results were substantially the same as before. It was noticed, however, that the final resistance was almost invariably slightly higher than the original resistance, but this increased resistance gradually diminished, and perhaps, if time were given, it would return to its original value. There is little doubt that this is a thermo-electric effect. Since, as is well known, the resistance of a continuous conductor of carbon is diminished by heat, it might perhaps be supposed that the diminution which the resistance of carbon contacts exhibits under the influence of increased currents is due simply to the heating effect of the current. Experiments made with the view of testing this hypothesis failed, however, to support it. The carbon balance, with a weight of 2 grammes in the scale-pan, was placed in an air-bath, the bulb of a thermometer being very near the points of contact; the temperature was slowly raised, and the resistance was from time to time measured in the ordinary way. At 16° (the temperature of the room) the resistance was 9 ohms. As the temperature rose the resistance varied irregularly, increasing, however, on the whole, and never becoming less than it was at first, until at 50° it had become 10·7 ohms. The experiment was repeated with a weight of 10 grammes in the scale-pan. The resistance at 17° was 4·7 ohms. As in the former case, the resistance rose and fell irregularly as the temperature increased until 31°, when it was 4·7 ohms—exactly the same as at first. From this point it increased with great steadiness and regularity to 5·7 ohms at a temperature of 50°.

Under certain circumstances the current appears to produce a permanent and not merely temporary effect upon the resistance; that is to say, the resistance of the contacts is found to be lower (or higher) after the current has ceased than it was at first. When the proportion of the current strength to the pressure at the points of contact exceeds a certain limit, the effect of the current is apparently to produce a permanent *increase* in the resistance, and this increase is sometimes very considerable. The resistance does not rise gradually, but suddenly, generally after the circuit has been closed for from two to ten seconds, and at the moment of the rise a minute flash of light appears at the points of contact. The galvanometer needle suddenly goes to zero, and when this has occurred no deflection whatever is produced on opening and closing the circuit with a key. A slight vibration, however, partly or wholly restores the conductivity of the carbon, and, curiously enough, the same effect is often produced by the feeble current used to measure the resistance. Thus it may happen that, while the moment before measurement the resistance may be infinity, the very act of measurement reduces it to a few hundred ohms.

The experiments made with metals were less numerous than those with carbon. Metallic loose contacts were found to be even more uncertain in their action than those of carbon, and to obtain a really fair average of results a very great number of measurements would be required. Under precisely the same conditions, as nearly as they could be reproduced, the results obtained were frequently very different. Nevertheless, it has been possible to bring out with sufficient distinctness some remarkable peculiarities in the behaviour of metallic contacts. The metal principally used was bismuth, which was selected on account of its high specific resistance, but a few experiments were also made with copper and platinum. The cylinders of bismuth and copper were of nearly the same diameter as those of the carbon previously used—6 mm. The platinum was prepared by soldering wires of that metal upon cylinders of brass.

The first unexpected phenomenon which attracted notice in working with bismuth was the very great permanent fall in the resistance which was produced by an ordinary current with light pressures. Using a single Leclanché cell, the lightest contact—the pressure being certainly less than ·01 gramme—failed to give a higher resistance than 9 ohms; but with 400 ohms inserted between the battery and the Wheatstone's bridge, a pressure of ·35 grammes gave a resistance which on different occasions varied between 73 and 110 ohms. When once, however, the resistance has been reduced by a strong current, the changes which occur when feebler currents are used are comparatively small, unless, of course, the points of contact are first separated. A *small* weight being in the scale-pan, if a weak current were caused to pass through the points of contact, the resistance was found to be high. When a strong current was passed, the resistance was greatly diminished. And when the current was reduced to its original strength, the resistance did not rise to its original value; in fact, did not rise at all, it was still further diminished.

Repeating with bismuth the experiments made in the case of carbon, it was clear that the diminution of resistance effected by pressure was generally of a permanent nature, continuing to a great extent after the pressure has been removed (so long as the points of contact remain undisturbed), and thus reversing the case of carbon. With strong currents the variations of resistance were so uncertain and irregular that accurate measurements were impossible; but with a resistance of 300 ohms between the battery and the bridge the effect was very clearly marked.

When a tangent galvanometer was inserted in the circuit it at once became evident that when the condition of the microphone was at its best the current was strongest. It appeared probable, therefore, that the magnitude of the apparent repulsive effect produced between two contacts, as discovered by Mr. Stroh, depended merely upon the strength of the current which was passing at the moment, and that the excellence of the microphonic effect had really nothing to do with the matter. The upper carbon was therefore pressed down with a weight too heavy to admit of the ticking of the watch being heard, and a steady current was thus secured without any difficulty. It was now found that the repulsive effect was almost, if not quite, as great as it was when the carbons were in loose contact, and little doubt was left that the phenomenon was merely a case of expansion due to the heating effect of the current. Cylinders of bismuth were then substituted for the carbon rods, and a similar effect was produced, the movement of the spot of light being somewhat greater than it was with carbon. With copper the apparent repulsion was rather less than with carbon, but perfectly well marked. Lead was then tried, being chosen on account of its high co-efficient of expansion and its inferior conductivity for heat and electricity, and, as was expected, the deflection of the spot of light was very considerable, being about six times as great as in the case of carbon.

The results of the experiments may perhaps throw some light on a matter which has never hitherto been fully explained. Why does carbon give far better results than any metal when used in the microphone? It seems that this question may be very easily answered. The mere fact that a current causes delicately-adjusted metal contacts to adhere to each other is sufficient to account for the superior efficiency of carbon. It is possible, indeed, to transmit articulate sounds by means of a metal microphone, as is proved by some of Professor Hughes' earliest experiments, but the action of such an instrument, as compared with one of carbon, is extremely uncertain and imperfect. This is, no doubt, due to the fact that, although vibrations corresponding to the fundamental tone are easily produced, the minute superimposed vibrations due to the upper partials, upon which depends the distinctive character of a particular sound, are, owing to the adhesion, very imperfectly represented, if not entirely lost.

The question as to whether it is preferable to arrange the elements in series or in multiple arc is very easily answered. If the elements are in series the whole of the current used will pass through each of them; while if they are in multiple arc the current will be subdivided and each element will be traversed by a current the strength of which (supposing them all to be equal) will be inversely proportional

to the number of elements. Now, the sensitiveness of the contacts to changes of pressure has been shown to increase greatly with small currents, and hence it follows that the multiple arc is to be preferred to the series system. The same reasoning, in a modified form, will condemn a system in which series and multiple arrangements are combined; for the greatest perfection, therefore, the multiple arc system pure and simple should be adopted.

Since the efficiency of a microphone depends principally upon its power of varying the strength of the current in a circuit comprising the microphone, a battery, and the primary wire of an induction coil, it is clear that the electromotive force of the battery should be as high as is consistent with other conditions, and the resistance of the battery coil and microphone should be low; for the proportional change of resistance caused by sonorous vibrations remaining the same, the stronger the maximum and minimum currents, the greater will be the actual difference between them. But for securing sensitiveness it is very important that the current passing through the microphone should not exceed a certain strength, and indeed, if the pressure is light (as it should be), a strong current will enormously increase the resistance of the contacts, or some of them, thus impairing or utterly destroying the efficiency of the instrument. The general conclusions that may be derived from the investigations are that:—(1.) The constituent elements of a microphone should be numerous. (2.) They should be arranged in multiple arc. (3.) They should be heavy. (4.) The pressure at the points of contact should be light. (5.) The resistance of the microphonic system should depend upon the resistance of the rest of the circuit (which should be small) and upon its sensitiveness to changes of pressure. In general it should be small. (6.) Up to a certain limit, depending upon the number of contacts and their pressures, the current used should be strong.

A second paper, read at the same meeting, will be found on p. 328.

The American Bell Telephone Company.—The annual report of the directors, which was presented at a meeting of the company held in Boston on the 28th ult., contained the following interesting statistics:—

	Jan. 1st, 1882.	Jan. 1st, 1883.	Increase.
Exchanges in operation ...	486	735	249
Subscribers	70,525	97,735	27,210
Miles of wire	49,168	69,452	20,284
Extra Territorial Lines.			
Licences issued	75	256	181
Miles of pole lines ...	2,007	6,154	4,147
Miles of wire	3,037	13,653	10,616

There were under rental February 20, 1882, 189,374 instruments, and February 20, 1883, 249,711, a gain of 60,337. The instruments manufactured and purchased up to February 20th, numbered 328,528, and were thus accounted for: In hands of licensees, 249,711; on hand available, 13,940; destroyed, 20,722; defective to be destroyed, 40,966; balance in suspense account, 3,189. The income from the interchange of telegraph business is double that of the previous year, although this branch has not yet assumed large proportions. The profits on the sales of instruments have decreased, foreign manufacturers having at last succeeded in making good telephones for their own countries. The reports from the local companies throughout the country are considered encouraging, many of them paying dividends. The underground wire experiments had thus far proved successful for short distances only. To secure further holdings in companies acting under the Bell licence, there was expended beyond the amount previously provided for the purpose, $1,750,000, which was met by temporary loans. To make permanent provision for this, and to furnish a fund for construction, &c., the increase of the capital stock was recommended. The statement of the treasurer for the year ending February 28th, showed the rental of telephones in 1882-3 to amount to $1,257,054·58, as compared with $885,312·92 in 1881-2, being an increase of $371,731·66. The total earnings of the company were $1,576,031·57, and in the previous year, $1,001,924·41, an increase of $574,107·16; and the net earning $972,044·28, as against $562,061·65, an increase of $409,982·63. The total expenses in 1882-3 were $1,098,078·86, and in 1881-2, $606,555·01, an excess of $491,523·85.

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CORRESPONDENCE.

Floundering into Failure.

I have only to-day seen the article "Floundering into Failure" in your impression of the 10th March, and having had some experiences of the management of electric light companies, I can quite endorse all you say on the subject.

I can also add, that the want of knowledge on the part of the managers, &c., of the most ordinary details in connection with the preparation of the two principal parts—the glass and carbon—that constitute the incandescent lamp, is most astounding to any one having a very slight acquaintance with the subject.

Again, the principal companies who are pushing incandescent lamps are so *loaded* with large capital, payments to inventors, royalties, commissions, &c., to agents, promoters, and others, besides the incompetent management above mentioned, that it is impossible for even the very best lamp to give either "light" or profit. In consequence of these drawbacks, and the high prices at which all lamps are offered to the public, the demand is not one-fiftieth part of what it ought to be.

What is wanted is a lamp to combine cheapness and simplicity, to be offered at 1s. 6d. each or less, and to be free of all *loadings* named. Such a lamp I have seen during the last few days, and the maker says it can be produced to sell at the price stated, and even less if there is a large demand.

L. H.

April 11th, 1883.

The Telephone.

In my communications published in your Review of 19th and 26th August last I gave lists of British patents for telephone receivers, beginning on 9th December, 1876, the date of Bell's patent, and ending on 1st January, 1882, specifying those receivers in which a disc capable of inductive action is used, and those in which a disc not capable of inductive action is used.

I now send lists of British patents for telephone receivers and transmitters dated before August 10th, 1882, and in classifying these two kinds of instruments I shall be guided by the judicial descriptions of Bell's claims, and of Edison's

claims given by Mr. Justice Fry and the late Master of the Rolls, and Lord Justice Bowen. Bell's claim was said by Mr. Justice Fry "to consist of a horse-shoe magnet, the ends of which are brought into the circuit by means of coils of wire, and in front of which is a metallic plate capable of inductive action placed at right angles to the length of the magnet, resting as regards its circumference in the wooden case."

The Master of the Rolls described Bell's invention as "a thin plate or disc, in front of the magnet, close to the magnet, separate from the magnet, fixed or attached, and in such a way as to keep the whole circumference fixed."

Lord Justice Bowen said, "It is to be a plate, at all events, in front of the magnet, and attached in front and close to it, with a fixed circumference."

List of patents dated before August 10th last for telephone receivers in which a plate is used as described by the above-cited Lords Justices:—

No. 688, February 11th, Hopkins; 689, February 11th, Hopkins; 922, February 25th, St. George; 3458, July 20th, Chaster.

List of patents in which a plate as described by the Lords Justices is not used:—

No. 2259, May 13th, Barney; 2578, May 21st, S. P. Thompson; 2675, June 7th, Alabaster, Gatehouse, and Kempe; 3008, June 24th, Husbands; 3335, July 14th, Yeates.

Mr. Justice Fry said that the essential requisition in Edison's transmitter is "the combination of a diaphragm or tympan with a tension-regulator," and that the word diaphragm in this case included any substance which separated the tension-regulator from the air-waves, either before or behind the tension-regulator.

List of patents for telephone transmitters dated before August 10th last in which there is a combination of diaphragm and tension-regulator:—

No. 316, January 21st, Ohmsted; 688, February 11th, Hopkins; 922, February 25th, St. George; 1044, March 4th, Theiler; 1177, March 14th, Husbands; 3008, June 24th, Husbands.

Transmitters in which there is not a combination of diaphragm and tension-regulator:—

No. 1684, April 6th, Dolbear; 3557, July 27th, Munro and Warwick; 3803, August 9th, S. P. Thompson.

Common Sense.

The Prospects of Electric Lighting.

Will you kindly permit me, as a representative of one of the companies whom your correspondent "A. J. Jarman" thinks are so very unprofitable, as set forth in his communication to you under the above title in your last issue, to take up the cudgels on behalf of the said companies, and to point out one or two facts which will show that the prospects of electric lighting are much better than they were twelve months ago, that real and substantial progress has been made, and that "what was hoped to be one of the most brilliant successes of the nineteenth century" is in no danger of ending in "lamentable failure" as predicted by your correspondent, simply because some of the companies have shown the public what they have been so "desirous of seeing," viz.: "a street or a terrace of houses lighted internally and externally by electricity."

It would not be difficult to show that your correspondent is either ignorant of what is going on in the electrical world, or that he simply ignores facts which are patent to every careful observer.

As, however, my object is not to criticise but simply to make a few plain statements from which your readers may draw their own conclusions, I will pass over the illogical deductions of your correspondent, and with your permission proceed to point out one or two directions in which substantial progress has been made.

I do not think that the public are so anxious for results as your correspondent appears to imagine, and as for one section of the public, viz., the investors, who twelve months ago subscribed so eagerly to electrical enterprise, probably 99 per cent. did so because they expected a profitable return for their investment, and not from any special sympathy with the enterprise in which they were investing.

If, therefore, there is any feeling of disappointment on the part of the public as to the results of the past twelve months, it is from an investor's point of view and not from a scientific one; and we must look in another quarter than the purely scientific and practical one for the causes which have produced the present financial depression.

To any one acquainted with the history and development of scientific discoveries and their practical application, it is simply a matter of unmitigated wonder that electric lighting has made such great and rapid strides. Those best acquainted with the subject know what an enormous amount of tentative and experimental work has to be done, and it has been chiefly this class of work which has been done during the past twelve months; work which at first sight would appear somewhat, if not altogether unprofitable, but which is a very essential part of the progress of the great whole.

Let us look for a moment at the way in which installations are now carried out as compared with what we know were the methods at first in vogue. Formerly a set of machines, lamps, &c., were sent out from the works, with perhaps a card of instructions; and an "electrician" was sent to direct the installation. Everything was done hap-hazard, or by rule of thumb; no testing instruments whatever were provided, even when applied for, as they were not considered necessary by those in authority.

The lamentable failures which resulted we all know. Though there is still room for great improvement, yet it cannot be doubted that the class of work done now is very superior to that which was formerly carried out. In the first place repeated failures have impressed in the minds of directors the importance of having practical men and a trained staff, and in the second place there has been time and opportunity to instruct and to weed the staff—the bad workmen have fallen out of the ranks, and the good ones have been retained.

I can answer, at all events, for the company I represent, that of all the numerous and extensive contracts we have carried out we have not had a single failure, and I am sure many of the companies could show equally good results.

From a practical point of view I put it that the work done during the past twelve months has been a very decided step in advance of the previous year, that real and substantial progress has been made in that practical knowledge which it is the constant endeavour of all workers to obtain, and by which alone the final result we all look for can be obtained.

Again, what has been the nature of the work done by the companies, and does this also point to real progress having been made?

The greatest amount of work done has been in the direction of contract lighting.

The actual sale of plant has been limited. It is easy to account for this. The public are very generally in favour of the new illuminant, and it has been in very general demand for soirées, exhibitions, bazaars, lectures, &c.

On the other hand, there is a very general feeling among would-be purchasers that the price of plant is too high, and must soon be subject to a general reduction; and they are therefore unwilling to purchase at present rates, though they are willing, and in many cases anxious, to hire the light at a reasonable contract price.

In a few places central distributing stations have been formed, but the Electric Lighting Act practically put a stop to this class of work being generally and immediately proceeded with.

However objectionable may be some of the terms of this Act, there can be little doubt that on the whole the effect will be to place electrical enterprise on a much more secure basis by preventing rash and unpractical speculations.

Shareholders must not grumble because their directors have not by this time obtained Parliamentary powers and established works in a score or so of different towns, which, as your correspondent puts it, appears to have been a great neglect of duty on their part.

None of the companies have sufficient capital to establish more than one or two such central stations, and the terms of the Act make it a matter of great difficulty to decide where such a station could be established remuneratively.

It is true that when the Act was first passed wholesale applications were made by many of the companies to every town of importance in Great Britain, but they were made

for a purpose and to force the hands of the corporations, who were very generally thrown into a state of extreme embarrassment by this action on the part of the companies.

A moment's reflection, however, would have shown that not one hundredth part of these notices could be sustained, and the panic produced by them has now subsided.

It is not therefore the fault of the companies that the great desideratum of central distributing works has not yet been realised to any great extent.

It is too much, however, to say that their possibility has not yet been demonstrated; and there is little room for doubt as to their general adoption in the future. Their growth, however, must be subject to the slow development which is necessary to the realisation of any great project (instance, the Atlantic cable).

Practical electricians know that many of the problems which have to be solved before a general scheme of distribution can be realised have advanced during the past 12 months from the region of theory to that of practice; but it is extremely difficult to convey to an outsider any idea of the nature or bearing of these problems, hence such letters as that of your correspondent, A. J. Jarman.

W. Kingsland, A.S.T.E.,
Engineer to the Yorkshire Brush Electric Light and Power Company, Limited.

Leeds, *April 16th*, 1883.

Duplex.

The following modifications of Mr. Jacobs' and Mr. Conti's methods of duplex working with several wires may prove interesting to your readers and is, I believe, novel:—In fig. 1, A, the two line-wires, L and L′, are looped and connected to differentially wound apparatus, and another set of apparatus, B, is connected to another-line wire, L″, and to

Fig. 1.

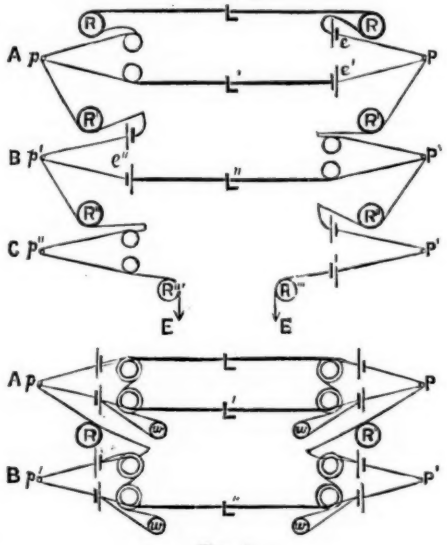


Fig. 2.

the centre of the A battery at the one end and the centre of the differential relay of A at the other end. When L = L′ and E = E′ the batteries, E, E′, would not produce any effect outside of the circuit, P, L, *p*, L′, the current flowing in direction P, L, *p*, plus current flowing in direction *p*, L′, P, would equal—

$$\frac{E}{L} + \frac{E'}{L'}.$$

The two lines, L L′, in multiple arc may be considered as one line with respect to the B apparatus, and the battery of B would not produce any effect on the apparatus of A, because when L = L′ the B battery would act with equal force in opposite directions on the differential instruments of A. Also by adding a resistance, R′, to the apparatus, B, so that

$$L = R' + \frac{L\,L'}{L + L'},$$

the battery of C would act equally and oppositely on the differentially wound coils of B and A; and if the batteries of B were equal they would produce no effect on the apparatus, C. Any number of circuits may thus be connected up so as to work as if they were separate circuits. The apparatus could be arranged with a pole-changer to reverse the direction of the current, the pole-changer or differential relay being put in the circuit with a switch, as the station wished to send or receive.

By a quadruple winding of the apparatus, as shown in fig. 2, *n* duplexes may be worked on *n* + 1 lines without an earth circuit, two rheostats would have to be adjusted, namely R, to prevent the batteries in one set of apparatus from affecting another set of apparatus, and ω, to prevent each battery deflecting its own apparatus.

This method would be advantageous in preventing induction between several lines running parallel between two stations.

And when earth currents are prevalent, *n* — 1 sets of apparatus might be worked upon *n* lines instead of only

$$\frac{n}{2},$$

when the lines are looped in the usual way. If an earth circuit is used on the last set of apparatus, as shown in fig. 1, only the last set of apparatus would be affected by earth currents.

W. Moon.

April 10th, 1883.

R. E.—We shall be glad to insert your communication, but we must first refer you to our paragraph respecting anonymous correspondence, page 331.—Eds. Elec. Rev.

NOTES.

Electric Lighting.—In the House of Commons dining-room and library, which, as we have before intimated, is now lighted by the Edison Electric Light Company, there are in all 265 incandescent lamps, three more being used in the engine-room. A cable of 150 ft. in length runs from the engine-room to the library and dining-room, where branch wires go to the clusters of lamps. Each chandelier is kept under perfect control by means of an automatic regulator. The contract for the lighting extends to the end of the present session of Parliament. In answer to Lord R. Churchill, Mr. Shaw-Lefevre explained that the Edison Company offered to light the libraries and dining-rooms of this House experimentally till the remainder of the session at a cost slightly above that of gas for the same period, and which works out at something under £100, they supplying the plant. He thought it in the interest of members to accept this offer without entering into any further obligation to the company. With respect to the future, he should, towards the end of the session, consult the wishes of members before making any permanent arrangement. In the present state of electric lighting, he did not think it a fit subject for competition. After careful consideration he did not think it wise to act on this principle, when he introduced the Swan system of lighting into the Law Courts. Replying to another question Mr. Shaw-Lefevre said it was not intended to introduce the electric light into the House itself.

The steamer *Cavalier*, recently launched from the yard of Messrs. Aitken & Mansel, Glasgow, for Mr. David Mac-Brayne, made a successful trial trip on Tuesday. The whole of the vessel is to be lighted by 50 Swan incandescent lamps. A special engine has been fitted up for this work.

The Savoy Theatre management, having determined to abolish gas-fittings altogether in the entrance, corridors, and offices, Messrs. Faraday & Son are supplying some tasteful fixtures for the Swan lamps with which Messrs. Siemens Brothers are replacing them. The corridors are now lit from some 80 pendants with 8-in. curved reflectors, the lamps depending therefrom only a few inches below the ceiling. The electrolier for the Royal room is a graceful

combination of five swans' necks with a festoon arrangement between the beaks, from which the lamps hang.

The Exhibition in connection with the Dewsbury and District Infirmary, which was opened during Easter week, has just been closed. The building, during the Exhibition, has been brilliantly illuminated by the arc and incandescent lights, these being run on the same circuit and from a 40-light Brush machine, driven from the shafting of a neighbouring mill some 200 yards distant from the building in which the lamps were erected. The arrangements for lighting were intrusted to the Yorkshire Brush Electric Light and Power Company, and were carried out very successfully.

At the Vienna International Electrical Exhibition there is to be, as we have previously mentioned, a pavilion specially constructed according to the wishes of the Emperor of Austria, and designed to show the effect of the electric light on cloths and broideries. Different systems will be exhibited.

The Academy of Painting and Sculpture at Berlin has been lighted by 200 Edison lamps. The dynamo is driven by a Ruston-Proctor engine of 16 horse-power.

At Buda-Pesth, the capital of Hungary, the National Theatre is to be lighted by 1,000 Swan lamps.

The Moscow municipality has voted a sum of 80,000 roubles for the illuminations on the occasion of the Czar's coronation, in May.

Health says: "The electric light has been supplied to a Vienna hospital. This is as things should be. The problems of ventilation will be in greater part solved when the electric light comes into general use."

Writing in *Longman's Magazine* on atmospheric purification, Dr. Richardson says: "But for clearance of smoke we must wait a little longer. Happily the day is dawning when that object is sure to be attained. So soon as the electric light wins its certain way, so soon will coal come to the fore and to the fire in the form of partly purified gas; cheap, ready to burn at a moment's notice, and yielding heat, without either smoke to obscure the air or sulphurous acid vapour to injure vegetation."

A Melbourne correspondent writes to the *Mining Journal* that already two gold mines are lighted by electricity and that others are introducing the electric light.

Particulars of electric lighting at Kimberley to hand state that the installation consists of 32 Brush arc lamps, supplied by two 16 lighters driven from a countershaft by a Robey engine of 20 N. H. P., which makes 130 revolutions per minute: the machines going at 800 per minute. One circuit, 3½ miles in length, extends round the Kimberley mine; the other circuit, 4 miles in length, to De Bier's mine, down Du Torts Pan and Victoria Roads. The wires are carried partly on poles, partly on the roofs of the houses. The light is giving great satisfaction. The work has been carried out under the superintendence of Mr. R. L. Cousens, A.S.T.E., and E., the electrician of the South African Brush Electric Light and Power Company, Limited.

Malicious Destruction of Telephone Plant.—Between the night of the 7th and the morning of the 8th inst., nine telephone wires belonging to the National Telephone Company, Limited, were maliciously cut at a standard erected on a building in Overgate, Dundee. This is the second time the company has had to complain of such mischief, no fewer than 43 of their wires having been cut on the night of the 3rd or morning of the 4th January last, at the same place. With a view to the discovery of the perpetrator or perpetrators of these acts, a reward of £20 has been offered for such information as will lead, within three months, to the apprehension and conviction of the offender or offenders.

Telephonic.—The John Cockerill Company has just installed at its Caine Colliery telephones connecting the overground with the underground works.

The Bengal Telephone Company.—The shares of the Bengal Telephone Company have been fully subscribed.

The Telephone in Cincinnati.—One hundred and thirty villages, within a radius of 75 miles, are within telephonic speaking distance of this city.

The Telephone in Providence.—The *Providence Journal* congratulates its city on doing, for its size, more "halloing" than any city in the world. There is a telephone subscriber to every 72 persons, while it is one to every 253 in Boston, to every 400 in New York, to every 471 in Paris, and to every 2,563 in London.

The Telephone in Boston.—An increase of 27,210 subscribers to the telephone in Boston is reported during the past year. What do our go-ahead telephone companies in England say to this?

Underground Telephone Wires.—The declaration of the Bell Telephone managers that a subterranean system of underground wires is at present unsuited to their system receives timely corroboration (says the *Operator and Electrical World* of New York) in a report by Lieut. Greene, recently published. Whatever may be said of the underground system for telegraphs and electric light wires, it cannot yet be adapted to the telephone for general use.

One Thousand Miles by Telephone.—On the 28th ult. experiments were made over the Postal Telegraph Company's wire in telephoning between New York and Chicago, a distance of about 1,000 miles. The instrument was the double Edison telephone, which consists of two Edison telephones attached to a single mouth-piece in such a manner that one can talk into both at the same time and get their combined effect upon the line connecting the two. It is thought (says the *Operator and Electrical World* of New York) that the great success attained must be attributed to the compound copper wires of the Postal Telegraph Co., through which the sounds are transmitted, of which the conductivity is about seven times as great as that of ordinary steel wire. They consist of a core of steel surrounded by a coating of copper, so combining the strength of the ordinary wires with the conductivity of the copper covering. Every word that was uttered could be heard distinctly, and the operators in Chicago were able, it is said, readily to distinguish the voices of the gentlemen in the New York office. In reference to this subject we would direct our readers' attention to the article "Long-Distance Telephoning," in our issue of April 7.

The All-night Opening of Telegraph Offices.—The Connecticut Legislature is considering a bill compelling telegraph companies to keep their offices, in towns of 6,000 inhabitants, open all night, and to furnish messages at all times.

The Sixpenny Telegram.—It is said that of the two Postal Secretaries who have now under their consideration the arrangements to be made in connection with the establishment of sixpenny telegrams, Mr. Patey is in favour of and Mr. Baines opposed to the abolition of free addresses. The following bit of information, gratifying to the Chancellor of the Exchequer, whatever it may be to telegraphists, is given by the *County Gentleman*:—"An enterprising firm of soap-boilers means to avail itself of the sixpenny telegraph system directly it comes into operation. I am told that it will send out 50,000 messages saying that all the best families use its soap."

Telegraph Office at Carrigallen.—In the House of Commons on Thursday week Mr. Fawcett, in reply to Colonel O'Beirne, said a memorial signed by the inhabitants of Carrigallen and neighbourhood, in the county of Leitrim, had been forwarded to the Post Office authorities, requesting that a telegraph office might be established in that town. It was estimated that a telegraph office at Carrigallen would not be remunerative, and he regretted that,

under the rules now in force, unless the residents would guarantee the Post Office against loss, it would not be in his power to recommend to the Treasury that the telegraphs be extended to Carrigallen.

The Durance of Telegraph Poles.—The Western Union Telegraph Company has estimated the durance of telegraph poles as follows:—Cedar, 16 years; chestnut, 13 years; juniper, 13 years; spruce, 7 years. Cedar, chestnut, and spruce are used in the Northern States, juniper and cypress in the Southern States, and redwood in California. Poles cut in the summer will not last as long as those cut in the winter by five years.

Personal.—The Queen has been pleased to confer the honour of knighthood on Mr. C. W. Siemens, F.R.S.

Society of Telegraph Engineers and of Electricians.—At the meeting of the Society to be held at 25, Great George Street, S.W., on Thursday evening, April 26th, the discussion will be continued on the following papers:—"On some new forms of Telephone Transmitters, with a Note on the Action of the Microphone," by Mr. John Munro, Associate; "On the Influence of Surface Condensed Gas upon the Action of the Microphone," by Mr. I. Probert and Mr. Alfred W. Soward, Associates; and "On Microphonic Contacts," by Mr. Shelford Bidwell, M.A., LL.B., Associate.

The Royal Society of Edinburgh.—The tenth ordinary meeting of this Society took place on the 16th inst. C. G. Knott, D.Sc., made a communication, "On the Measurement of Resistance of Electrolytes." After reference to the studies of Becker, Beetz, Paalzow, Kohlrausch, and others, Dr. Knott described his own method, which briefly consisted of a tube laid horizontally and fused into two vertical tubes. Dilute sulphuric acid filled the tubes, and in them dipped the electrodes. Two Bunsen cells were used, an electrometer and a standard coil. This arrangement is not susceptible of very accurate tests, nevertheless it is good for rough purposes, giving tolerably satisfactory results. Polarisation was not entirely eliminated, but the deflection on the electrometer could be manipulated until the readings when a current was passing and when a current was not passing were similar (?) Dr. Knott found that the resistance was dependent on the density of the solution, and he also found that when estimating the specific resistances that the results were too high as compared with those found by other investigators. With an intimation that the experiments would be repeated with longer tubes the paper closed. The next paper, by the same author, was descriptive of experiments made and results observed "On the Electrical Resistance of Hydrogenised Palladium." The object of the experiments was to gain definite knowledge on the subject. The palladium wire was charged according to the method of Mr. Dewar. The hydrogen was next condensed on the palladium, so that one could easily see the hydrogen given off, which was very similar to that given off by platinum. To purify the palladium it was heated to a red heat; this seemed to be the only possible method, which, however, was destructive of the palladium, so that it was no longer useful for any purpose (?)

Professor Tait read a "Note on the Thermo-Electric Position of pure Ruthenium." In introducing his note Professor Tait said, "I may mention that I have succeeded in obtaining a specimen of pure iridium. As iridium as a metal is scarcely ever seen I may lay this specimen before the society as a very interesting and curious one. It is a mere fragment, yet it was prepared with great care. The results seem to show that by means of iridium and pure ruthenium I shall be able to form a standard thermo-electric couple, if the metals are pure, something procurable, something by means of which comparison can be carried on all over the world. I shall have at last found that which I have long searched for, a definite standard for comparing temperatures—very high temperatures, such as furnaces, &c., for which at present we have no suitable instruments.

The Jay-Gould Cables.—It is rumoured, but we know not whether correctly, that one of the Jay-Gould cables is at present interrupted.

L'Association Française pour l'Avancement des Sciences.—This Society will hold its next congress at Rouen, from August 16th to 23rd, under the presidency of M. Frédéric Passy.

The Vienna International Electrical Exhibition.—*Le Journal Officiel* publishes a decree authorising an extraordinary grant of 80,000 francs to the French Ministry of Posts and Telegraphs for expenses in connection with the Exhibition. At the last meeting of the local committee it was announced that the applications for space had increased since the previous meeting from 155 to 317, and were still coming in in large numbers. From Austria-Hungary there were 173 applications, from Germany 64, from France 18, from England 16, from Italy 14, from Belgium 9, from Switzerland 6, from Russia 6, from North America 5, from Denmark 3, and from Holland 2. In the course of the last month exhibitors' applications have greatly increased. S. Schuckert, of Nürnberg, will exhibit dynamo-electric machines for electric lighting and transmitting power, incandescent lamps, and arc lights, a boring machine for coal mines, driven by electricity, the locomotive lamps of the Austrian electrotechnologist; Hermann Sedlaczek, dynometers, &c.; Alexander Kovaco, St. Petersburg, a rich collection in the department of galvanoplastic, and C. L. R. E. Menges, of the Hague, dynamo-electric machines, instruments for electrotechnical measurements, electric lamps and clocks, and in the Conveying Power Department novelties which hitherto have not been exhibited. Paul Rebikoff, of Moscow, intends showing, in addition to a series of instruments for electric measurements, a dynamo-electric machine for driving differential lamps on a new system, and different new electrical apparatus. Fleeming Jenkin, Professor at the Edinburgh University, will exhibit, under the name of "Telepherage," a system of automatic electrical transport only lately patented; Profs. W. E. Ayrton and John Perry, a new system of electric railways; James Coxeter & Son, batteries and electrical baths; the Société Gramme, various magneto and dynamo-electric machines, accumulators, and primary batteries; l'Eclairage Electrique, dynamo-electrical machines and Jablochkoff candles, and the Compagnie Electrique, dynamo-electric machines for transmitting power. F. O. R. Götze, Leipsic, will show the phosphoric apparatus of the Vienna electrotechnologist, Dr. Puluj, besides Crookes' tubes, various radiometers, an apparatus after De la Rive for showing the rotation of electric light around a magnet, and Geissler's tubes; the Duplex Electric Light, Power, and Storage Company, Limited, London, dynamo-electric machines, arc lamps, duplex incandescent lamps and batteries; Felten and Guilleaume, of Mühlheim, near Cologne, a fine collection of cables, wire ropes, and wires for divers electrotechnical purposes. Among the other exhibitors will be the India-rubber, Gutta-percha, and Telegraph Works Company, Limited, from their French branch at Beaumont-Persan; G. B. Pirelli, F. Lasassa & Co., Milan; T. O. Mouchel, Paris; M. Baur & Co., Paris; George Montefiore Levi, Anderlecht, near Brussels; the Telegraph Construction and Maintenance Company, Limited, London; Walter T. Glover & Co., Manchester, and the Electrical Power Storage Company, Limited, London, who will show accumulators for 200 incandescent lamps, and a boat, driven by accumulators.

The Charge against a Company Promoter.—M. Simon Philippart, who has lately promoted several electric lighting companies, and who was arrested in Paris at the instance of the Brussels authorities, who demanded his extradition on a charge of forgery and of having obtained money by false pretences, will probably be given up to the Belgian authorities, as his books, it is said, are discovered to have been tampered with.

Electrical Engineering.—At a meeting at Ithaca, N. Y., on the 26th ult., the trustees of the Cornell University authorised the establishment of a course in electrical engineering on the opening of the new physical and chemical laboratories in September next. A very extensive collection of apparatus has been received for the purpose.

Fire Proof Paint.—The buildings of the great International Fisheries Exhibition, which are constructed entirely of wood, have, we are informed, in consequence of their being coated inside and out with asbestos patent fire-proof paint of the United Asbestos Company, Limited, been insured by the Phœnix Fire office, at the exceptionally low rate of 2s. 6d. per cent.

Electricity: a New Commodity.—Mr. William Kingsland, A.S.T.E., delivered a lecture at the concluding *soirée* in connection with the Dewsbury and District Infirmary Exhibition, on Friday, the 13th inst., entitled "Electricity: a new Commodity." The lecturer clearly demonstrated the ease with which the electric current could be subdivided and applied for various purposes simultaneously. This was done by many striking experiments with the electric light and the transmission of power; the current employed for these experiments being that supplying the lights in the building at the same time.

Electricity for Tramways.—During the discussion on the Kirkcaldy and District Tramway Bill, Sir Arthur Otway, Chairman of the Committee, said, in speaking of steam-power:—"It is not a question whether the Local Authorities approve; I myself am not favourable to steam-power in any tramways unless you can show, which is not done, what sort of engines you are going to employ, what noise you will make, and what fuel you are going to burn. I think it would be very undesirable for the people of Kirkcaldy if you were to go on steaming away for seven years without knowing what is most economical. The company looks to have a good return for the shareholders. It might, for instance, be desirable to turn your tramways into electrical ones. It is quite within probability that all these things will be made to go with electricity, and then we will get rid of all the nuisances caused by steam. The moment electricity is proved to be more economical than steam, you will wish to get rid of steam."

The Great Mathematical Prize.—Last week we intimated that a shameful trick had been played on the Academy of Sciences, Paris, the Königsberg student, Hermann Minkowsky, who, with the late Prof. Henry J. S. Smith, was declared to have gained the great mathematical prize of 3,000 frs., having simply pirated Prof. Smith's communication to the Royal Society, in 1868, on the representation of a number as the sum of five squares. The *Times* Paris correspondent, writing on Monday, says the Academy was sharply attacked on the subject at its meeting that day, M. Bertrand undertaking the defence of his fellow-committeemen and himself. This is certainly, continues the correspondent, a striking proof of academic fallibility. As if there were a fatality in blundering, the very motto of Prof. Henry Smith's paper, which was a distich, was printed by the Academy as prose. It not only offered a prize, moreover, for a problem solved fifteen years before, but divided that prize between the man who had laid down the general principles of the representation of numbers by sums of squares, and a disciple who, although he had not seen that particular solution in print, had simply to apply Prof. Smith's principles. Minkowsky did not, indeed, absolutely plagiarise Prof. Smith's solution, for the latter, in his paper sent to the Royal Society, simply gave the results for the case of five squares and omitted the demonstrations. But the Königsberg student did not acknowledge whence he derived the method by which the problem was solved. The Academy has evidently itself to thank for this derogatory affair. It was either ignorant of Prof. Smith's researches of 1867, or it acted as if it were ignorant by offering a prize for a portion of the subject which he had exhaustively handled.

Profits of Telephone Companies.—The telephone companies managed in Lowell, Mass., have declared quarterly dividends, payable April 25, to stockholders of record of April 1st, as follows:—National Bell Telephone Company of Maine, on new stock, 1¼ per cent.; Boston and Northern, 3 per cent.; Bay State, 2¼ per cent.—increase ¼ per cent.; Suburban, 2½ per cent.—increase ½ per cent.; Union, 1½ per cent.; the Granite State Company of Manchester, N.H., 1½ per cent.

New Telephone Company.—Papers were filed at Albany on the 14th inst. organising the Globe Telephone Company, with a capital of $10,000,000, for doing a telephone business throughout the United States. The purpose is to use instruments that will overcome all the present obstacles and talk over the longest distances.

Jay Gould's Yacht.—Jay Gould wants his friends to recommend a name for his new yacht, in which he will go to Europe in June. We should suggest "Western Union," as that floats on water about as well as anything we know of. —*Lowell Citizen.*

Capital Stock of Two Telephone Companies.—The capital of the American Bell Telephone Company is $10,000,000. That of the United States Company, founded on the McDonough and Co.'s patents, and which is now fighting hard to break the Bell monopoly and gain a foothold, is also $10,000,000.

Motive Power by Alternating Currents.—One of the exhibits of Messrs. Gaulard & Gibbs at the Royal Aquarium is that of a Jablochkoff electro-motor, actuated by one of their secondary generators, which produces alternating currents.

An Electric Fire Alarm for the London Streets.—We understand that Messrs. Griffith & Co., telegraph engineers, of 4, Queen Anne's Gate, S.W., have, with the sanction of the Metropolitan Board of Works, on the recommendation of Captain Eyre Shaw, C.B., chief officer of the Fire Brigade, arranged to provide, tentatively, six fire alarms in connection with the King Street fire station in that portion of the western district which comprehends Golden Square, Piccadilly, Pall Mall, St. James's Square, Bruton Street, and Oxford Street (near the Pantheon). The apparatus supplied by Messrs. Griffith & Co. is known as "Spagnoletti's system," which obtained a silver medal at the International Electric Exhibition of Paris, 1881, and will in the course of a few days be placed in the streets above named, under the direction of the engineer-in-chief of Her Majesty's telegraphs.

NEW COMPANIES REGISTERED.

Gérard & Co. (Limited).—Capital £40,000, in £10 shares. Objects: To introduce into the United Kingdom the inventions of M. Jean M. A. Gérard-Lescuyer & Co., of Paris, and to acquire the English letters patent relating thereto. To manufacture electric lamps and apparatus, and generally to carry on the business of an electric light company in all branches. Signatories: *R. R. Jackson, Sydenham; *John Bruce, Edinburgh—10 shares each; *G. Nussbaum, Paris; W. B. Campbell, Anerley; J. E. Kingsbury, 67, Brailsford Road, Tulse Hill; W. J. Monfries, Sarsfield Road, Wandsworth Common; H. Pritchard, 1, Crescent Road, Wood Green—1 share each. Directing qualification: 10 ordinary shares. Messrs. F. F. Beggs, Edinburgh; J. G. Lorrain, of 2, Victoria Mansions, S.W.; W. A. Smith, of Glasgow; and J. M. A. Gérard-Lescuyer, of Paris, are directors. Registered, 11th inst., by Burton & Co., 37, Lincoln's Inn Fields.

Chamberlain & Hookham (Limited).—Capital, £100,000, in £10 shares. Objects: To apply electricity to lighting and other purposes, and to acquire a licence to manufacture meters and other apparatus, under the letters patent No. 49, dated 4th of January, 1882, and No. 3576, dated 27th July, 1882. Signatories (with 1 share each) *Arthur Chamberlain, Birmingham; Philip Hookham, Gravelly Hill, near Birmingham; *G. Hookham, Mosely, near Birmingham; Richard Chamberlain, J.P., Edgbaston, Birmingham; F. Ryland, West Bromwich; J. A. Kenrick, J.P., Edgbaston; R. P. Hookham, Oxford. Directing qualification, 50 shares, or £500 stock. Registered 14th inst., by Field, Roscoe & Co., 36, Lincoln's Inn Fields.

Signatories whose names are preceded by an asterisk are also directors.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Electrical Power Storage Company (Limited).—The annual return of this company, made up to the 4th inst., was registered 13th inst. The nominal capital is £800,000, in £2 shares. Of an issue of 300,000 shares 292,000 have been taken up; upon 50,000 of these a call of £2 per share has been made, the remaining 242,000 being considered as paid up. The calls paid and considered as paid, amount to £583,000, leaving £1,000 unpaid. Registered office, 4, Great Winchester Street Buildings.

NEW PATENTS—1883.

1848. "Electric lamps." A. Partz. Dated April 12.

1857. "Electric telegraphs." A. A. Favarger. Dated April 12.

1871. "Electric lamps." A. P. Lundberg. Dated April 13.

1877. "Apparatus for measuring electric currents and electrical pressure or potential." R. E. B. Crompton and G. Kapp. Dated April 13.

1889. "Electric cables or conductors and machinery for manufacturing the same, which invention comprises an improved method of and apparatus for placing such conductors in underground conduits." W. R. Lake. (Communicated by W. J. Phillips and G. L. Kitson.) Dated April 13.

1895. "Generating and applying electricity for medicinal or other purposes and means employed therefor." R. V. Ash. Dated April 14.

1911. "Electrodes for electric arc and incandescent lamps." W. Houghton. Dated April 14.

1924. "Improvements in electrical heating and in apparatus connected therewith." J. S. and R. P. Sellon. Dated April 16.

1932. "Galvanic batteries." C. L. Clarke. Dated April 17.

1952. "Apparatus for transmitting electrical signals at a distance." C. D. Abel. (Communicated by B. Abdank-Abakanowicz.) Dated April 17.

1956. "Telegraphic apparatus." C. J. Houghton. Dated April 18.

1969. "Construction of receptacles for secondary batteries or electrical accumulators." G. Binswanger and T. S. Sarney. Dated April 18.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

3812. "Electric, secondary, or storage batteries." J. S. Beeman, W. Taylor, and F. King. Dated August 10. 6d. Consists in the formation of electrodes by means of ribbons, tapes, strips, or such-like of convenient metals or of insulating material covered with metal, combined with lead salts. Also ribbons, tapes, or such-like of convenient metal, combined with ribbons or tapes of lead and lead salts. And in combination with the above improvements or otherwise, the use of an insulating ribbon, tape, or strip, alone or to form a carrier or vehicle for salts of lead, or lead in a finely divided condition, such insulating carrier being sandwiched, so to speak, between the improved metal ribbons or their substitutes. The ribbon, tape, or strips of metal, including lead, as also the insulating carrier, or either of them, may be made in any convenient manner, and they may be corrugated longitudinally and transversely, or either, and the metal ribbons, tapes, or strips, may be perforated or formed of or out of gauze or of plaited wires. Also of powdered carbon, graphite, or other similar and inert materials for covering the insulating strips alone or in combination with salts of lead, and the coating of said strips with the powdered inert material on one side and with salts of lead on the other. Also of an improved cell made of wood soaked or coated with paraffine, lined with a cell of paper equally treated with paraffine, and having a layer of paraffine interposed between the wood and paper cell.

3813. "Regulating and measuring electric currents." J. S. Beeman, W. Taylor, and F. King. Dated August 10. 6d. Consists in the manufacture of a cell, on the principle of a storage or secondary battery, with or of plates proportioned to the amount of current to be stored or used, the whole or a portion only of such plates and battery being divided off by an air or gas-tight chamber closed at one end with a fluid joint and fitted with a telescopic chamber or elastic diaphragm or piston, in such a manner that the gas evolved from the battery by its pressure on the telescopic chamber or equivalent causes the same to rise and fall, and move suitable indicating and contact-breaking apparatus, or actuate a train of wheels with a recording device, and also by means of an actuating lever or other equivalent, shunt or cut off the current from the battery or generator. Or in lieu of the chamber being telescopic, it may be closed at one end and at the other with a fluid joint, when the gas evolved will cause the liquid to be forced out in the open space, and there actuate a float or other equivalent, and effect the same results.

3814. "Electric-lamp apparatus." H. J. Haddan. (A communication from abroad by C. F. Brush, of America.) Dated August 10. 6d. Relates to incandescent electric lamps, and consists in the combination with a filament of "horse shoe" or equivalent form of a screen between the limbs; also in making filaments with a surface or surfaces so disposed that "radiant matter" projected from one limb of the filament and in directions normal to the surfaces thereof will not be intercepted by the other limb; or with a surface or surfaces so disposed that "radiant matter" projected from one portion of the filament and in directions normal to the surface thereof will not strike other portions of the filament. The screen may be made of metal, porcelain, glass, or mica, and of sufficient dimensions to screen and protect each limb of the filament from the action of the flying molecules from the other limb, and may be flat, curved, or tubular to enclose one limb, or each limb, or a split tube may be used. Two or more of such screens may be used. The lamps can be of any suitable form or construction and the screen or screens, which may be opaque or transparent, fixed in any convenient method. The incandescent filament is made angular in cross section and so disposed that "radiant matter" from each limb being projected in directions normal to the surface thereof will not strike the other limb.

3824. "Meters for the electric light." A. M. Clark. (Communicated from abroad by L. Hours-Humbert and J. de Brancion de Liman, of France.) Dated August 10. 10d. In electric lighting the electric tension should be automatically kept constant by the generator, but the consumer cannot (save in systems altogether exceptional) regulate the supply of electricity to each lamp. An electric lamp, therefore, burns from the moment the circuit is established always at the maximum intensity, and is only under the consumer's control so far as regards the time during which it may be kept in action. A meter registering accurately the sum of the periods during which each lamp has burned would, therefore, answer all the requirements of this system of lighting. Such an apparatus would be a time meter; but as the consumption of electricity is directly as the time, it will thus be indirectly a meter of consumption. This is the principle of the chronometric register of the present invention.

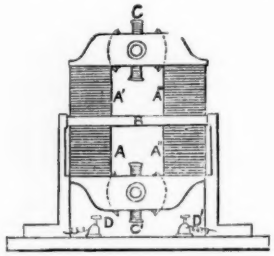
3825. "Electric-motors." S. H. Emmens. Dated August 10. 2d. Relates to certain improvements in solenoids employed as electric-motors, and further to the method of application thereof to various mechanical requirements. The main object of the said improvements is to construct a solenoid, any portion of which may be brought into operation at pleasure, so that the plane of maximum attraction may be made to advance or recede, thus rendering possible an equable and continued action upon the moving core. (*Provisional only.*)

3827. "Vessel for automatically compressing and storing air by the action of the waves, and generating electricity." C. W. Harding. Dated August 10. 6d. For this purpose the inventor places at a suitable distance from the shore a floating vessel of circular, or other suitable shape, and moored in four places and at right angles to each other. In the interior of this vessel are arranged air-tight compartments or receivers of suitable shape and construction, for the purpose of containing and storing compressed air in manner hereinafter described. In order to charge these air compartments or receivers, the inventor fixes one or more air-pumps which are actuated by a crank-shaft rotated by a chain-wheel by means of ratchet gear as follows:—Over the said chain-wheel is passed a chain, the lower end of which is attached to a permanent weight, sunk to, and resting on, the bed of the sea, to which it passes through a tube in the centre of the bottom of the vessel; the other end of the said chain passing through a similar tube in the bottom of the vessel and attached to a smaller weight hanging a short distance from the bottom of the vessel. It will be seen that by this arrangement the upward motion of the vessel caused by the buoyancy of the waves will impart a rotary motion to the chain-wheel, and consequently, by means of the gearing referred to, will set in motion the air-pump or pumps, resulting in charging the air compartments or receivers with compressed air at a high pressure.

3861. "Electric incandescent lamps." Gustav Pfannkuche and A. A. Dixon. Dated August 12. 2d. Relates to the construction of electric incandescent lamps. According to the invention, the inventors take strong fibres, such as hemp or flax, after it has been dried, and the outer hard skin removed and has thus acquired hair-like condition, as if ready for spinning; they then by preference clean it by exposure to an alkaline solution or acidulated water and after arranging the fibres parallel with each other, they bind them together by soaking in a heavy hydrocarbon oil or in a mixture of saturated solution of sugar and lamp black and gum, or similar binding solutions. After this process they compress, by means of presses or otherwise, into a plate or rod or board or any other shape convenient for the purpose. Off this raw material, while still in a flexible state, they take pieces without cutting across the fibres constituting the material, gauge them by drawing through a round-edged hold in a draw-plate or otherwise, then carbonise by baking in a crucible filled with graphite, or in a strong vessel containing hydrocarbon gas and exposed to heat, and after having done this they bring the carbonised material down to the required resistance by depositing carbon on the surface by means of carbonaceous vapours or other well-known means. (*Provisional only.*)

3869. "Dynamo-electric motor machine." E. Desfossés. Dated August 14. 4d. The features of novelty in the present invention consist (1) in the employment of magnetic pinions formed of bobbins, whose number would vary in proportion to the power to be produced by the motor, and (2) in dividing the inductors by a

separating piece so as to form two electrics ! ! ! The fig. represents an apparatus embodying the invention—A A^1 A^{11} A^{111} are the inductors. B the piece dividing the inductors, C C^1 are the magnetic pinions. D D^1 are the points of reception and of exit respectively of the electric current. The following is a description of the action of the apparatus.



The current enters at D, passes to the inductors, A A^1, thence to the upper magnetic pinion, C, by aid of some suitable friction device, the current then passes to the lower magnetic pinion, C^1, by means of a second friction apparatus, and from here it passes to the inductor, A^{11}, by a third friction apparatus, then to the inductor, A^{111}, whence it makes its exit to pass out at D^1 to enter the generator.

3893. "Secondary or storage batteries." H. J. HADDAN. (A communication from abroad by Dr. H. Aron, of Berlin.) Dated August 15. 2d. This invention consists in the first place in impregnating capillary substances by immersion, brushing, pressure under the jar of an air-pump, or by other pressure, with a lead combination (chemical), which substance so impregnated is then wound around the polar plates and there secured. The invention consists in the second place in constructing the polar plates, on the same principle, by stitching the capillary substance or net-work first on to the lead plates and then impregnating them with the lead combination or pressing the lead metalloid, or another lead combination or lead sponge, or a mixture of both, into the same. By repeating this manipulation, thicker strata may be produced on the same polar plates. (*Provisional only.*)

3906. "Electric lamps or lighting apparatus." W. R. LAKE. (A communication from abroad by P. Tihon and E. Rézard, both of Lyons.) Dated August 15. 6d. Fig. 1 is an elevation of a lamp constructed according to this invention. Fig. 2 is a plan of the same. Referring to figs. 1 and 2—upon a disc, D, of marble, wood, or other

FIG. 1.

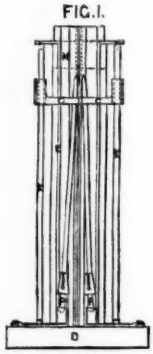
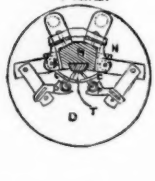


FIG. 2.



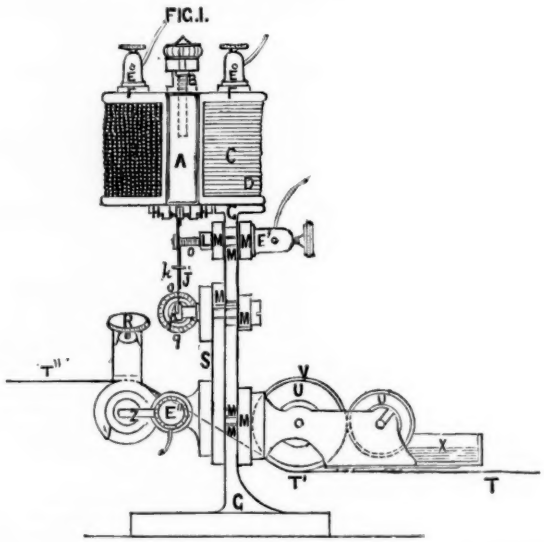
insulating material is placed a standard, M, of prismatic form and composed of fire-clay, in which is fitted a rod, T, of refractory material, by means of a dovetail joint likewise composed of refractory material. This standard, M, is supported by two metallic standards, N, N, connected at their upper extremity by a cross-piece electrically insulated. In front of this standard, M, are placed two carbon-holders, P, jointed or resting in cup-shaped cavities and moving in two vertical planes, having their point of intersection parallel to the axis of the refractory prism and adjacent to the said axis, so that the carbons, by their own weight, are caused to rest against the rod, T, without touching one another; a tongue or rib, which slightly projects from this part throughout its entire length, guides the points of the carbons and keeps them at a proper distance apart. At the side of each of the metallic standards, N, is fixed a vertical rod, K, along which moves a metallic slide, C, which presses against the carbons and insures the progressive descent of their points against the refractory rod as the consumption proceeds. These slides also serve the purpose of conveying the electric current to the carbon-points, thus preventing it from traversing the entire length of the said carbons. The operation of the lamp is as follows, that is to say: The carbons being lighted at their points by the passage of the current, the voltaic arc is established against the surface of the refractory rod and renders it incandescent. This state of incandescence facilitates the passage of the current, fixes the arc at a given point, and imparts absolute steadiness to the light emitted, the incandescence of the refractory rod doing a similar duty to that of a fly-wheel in an engine, accumulating and distributing the light with regularity notwithstanding the intermissions of intensity in the generating current.

3912. "Strengthening and checking electric currents." P. ADIE and W. S. SIMPSON. Dated August 16. 2d. Relates to the strengthening of the effects produced by electric currents, both as applied to telephones and telegraphs and all electric currents passed through wires, so as to produce more audible or visible results or to strengthen the power transmitted through such wires, and also an easy mode of connecting or disconnecting the apparatus or current. The manner in which this is carried into effect is by placing a battery or batteries near the receiving end of the wire or cable, and passing the message, so to speak, through such battery or batteries. This is found greatly to increase the effect of the current giving greater sound in the telephone and so enabling it to be applied to greater distances; likewise with the telegraph when currents are feeble or interfered with, giving resuscitation to them and increasing the effects of electric currents generally, as in the application of these currents to produce motive power. (*Provisional only.*)

3941. "Secondary batteries." N. C. COOKSON. Dated August 17. 2d. The inventor forms the positive and negative elements of the secondary battery of one or a series of continuous lead wires.—(*Provisional only.*)

3946. "Apparatus for receiving and recording telegraphic signals." B. H. CHAMEROY. Dated August 17. 6d. Relates to telegraphic receiving apparatus in which the signals are received and recorded by means of solutions decomposed by the ozone produced by the passage of an electric spark through the air. Fig. 1 is a side view, and fig. 2 a front view of the apparatus. It consists of an electro-magnet, A, fixed by an adjustable screw, B, and surrounded by a bobbin, C, round which is coiled insulated wire, D, the ends of which are in electrical connection with insulated terminal binding screws, E, E, fixed to the bobbin and insulated by the washers, F, F. The bobbin is fixed to a frame or stand, G, and is provided with a cross-piece, H, upon which is adjusted a magnet, I, turning upon pivots in H. The lower part of the pivoted magnet, I, carries a light projecting arm, J, upon which fits a movable adjustable projection, K, of non-conducting material. At each side of the projecting arm, J, is fixed a metal stud or pin, L, L, insulated by washers, M, M, M, in connection with a third binding screw, E^1, to which a wire can be attached, and each of these studs, L, L, has wound round it a light wire, O, O^1, which can oscillate freely upon the stud, and

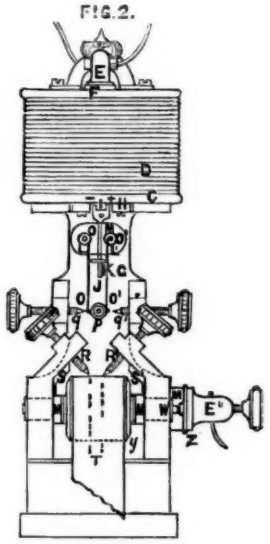
FIG. 1.



the lower end of which projects downward, the two wires hanging parallel one upon each side of a stop, P, of non-conducting material fixed between them to the frame, G, of the apparatus. On each side of this stop, P, is arranged, outside the lower ends of the descending wires described, the point of a metal screw, Q, Q^1, the exact position of which can be regulated as desired, and each of these metal screws is in electrical connection by conducting plates, S, S^1, with one of two corresponding adjustable screws, R, R^1, the points of which are arranged so that they can be adjusted at any desired distance from the surface of a metal drum, Y, of convenient size which revolves beneath them, and over the surface of which passes a strip of paper, upon which the signals received are to be recorded, the strip of paper first passing round the surface of a roller covered with felt or other absorbent material impregnated with a sensitive solution contained in an adjoining vessel, *x*, whence it is transferred to the felt by means of one or more similar rollers, U, V. The metal drum, Y, over which the impregnated paper passes, is insulated from the frame of the apparatus by insulators, M, M, but is in electrical connection by

a conducting plate, Z, with a fourth binding screw, E^{11}, to which a wire can be attached. The action of the apparatus is as follows:—An electrical induction apparatus, or other similar device producing a spark, is arranged so that its wires are in connection with the binding screws E^1, E^{11}, described, and it is then set in operation so as to produce a rapid succession of sparks, and the binding screws, E, E, being connected with the line wire through which signals are to be sent, the apparatus is ready for use. When notice is received that a message is about to be transmitted, an attendant sets in motion a train of clockwork which draws forward the strip of paper, T, T, over the metal drum, U, after it has been impregnated with the solution from the vessel, X, which saturates the felt roller, V, round the surface of which it has first passed. The paper presents its surface thus sensitised to the points of the two screws, R, R^1, adjusted above it as already described. If, whilst the paper is thus travelling, a current is transmitted along the line wire, it passes in one or other direction by the terminals, E, E, through the coil, D, and the electro-magnet, A, affected by the induction of the current passing through the bobbin, C, will have a magnetic pole formed at each of its ends, and the pivoted magnet, I, will oscillate upon its centres with a

FIG.2.



movement the more energetic as the electro-magnet presenting one of its poles attracts the opposite pole of the pivoted magnet, I, and the current passing through the coil acting inductively on the magnet, I, increases the oscillating movement of the latter. By this oscillating movement of the magnet, I, and of the lower projecting arm, J, upon, it which carries upon it the adjustable projecting piece of non-conducting material, R, the latter drives one or other of the suspended wires, O, O^1, toward the screws, Q, Q^1, opposed to them, and a stream of sparks will instantly pass between such suspended wires, O or O^1, and the point of the screw, Q or Q^1, and thence through the corresponding screw or point, R or R^1, above the sensitised paper, whence a corresponding stream of sparks will pass to the moving paper and through it to the metal drum, Y, over which it travels, generating ozone as they traverse the air, and decomposing the solution with which the paper is impregnated, at the point where the sparks pass, and leaving a number of visible marks equal to the number of sparks. Two lines of parallel marks will be produced upon the paper, one if the pivoted magnet oscillates to the right and the other if it oscillates to the left, according to the direction of the main line current. The current from the induction apparatus passes by E^1, L, O, Q, S, R, Y, W, Z, E^{11}, or by E^1, L^1, O^1, Q^1, S^1, R^1, Y, W, Z^1, E^{11}. If the main line current is interrupted the electro-magnet, A, becomes neutral, and the pivoted magnet, I, resumes its horizontal position, its projecting end, J, being vertical and the suspended wires, O, O^1, hanging by their own weight against the central stop, P, the distance between the wires, O, O^1, and the screws, Q, Q^1, opposed to them being too great for the sparks to pass, and the strip of paper, T, then travels forward without receiving any mark. In order to adjust the apparatus it is therefore only necessary, having determined the length of the sparks, to give a somewhat greater distance between the suspended wires, O, O^1, and their opposing screws, Q, Q^1. Directly the movement of either of the suspended wires, O, O^1, reduces this distance to that of the length of the sparks the latter will pass as described. By the method of arrangement described, two marking points or screws are used, making parallel lines of marks, but if one only is used it is only necessary to connect the two points, R, R^1, together electrically, and to leave only one of them sufficiently near to the paper for the sparks to pass. The signals will then have a significance dependent upon the time of their duration. The sensitising solution may be of any suitable kind possessing the property of being decomposed by the passage of the electric spark, as, for instance, iodide of potassium dissolved in water.

3949. "Apparatus for supplying electricity for light, power, &c." T. J. Handford. (A communication from abroad by T. A. Edison.) Dated August 17. 6d. The object of this invention is to produce simple and efficient means for reducing the tension of a continuous current flowing in a main circuit, and supplying consumption circuits with a continuous current of lower tension, whereby a large saving can be made in the investment for conductors, by using small main conductors, and obviating excessive loss of energy by the use of a current of high tension in the main circuit, while lamps, motors, or other translating devices requiring a continuous current can be supplied, and, by the use of a current of lower tension in the consumption circuit, the translating devices can be placed in separate multiple arc circuits and made independently controllable. The object is accomplished by the use of induction apparatus located between the main circuit and the translating devices, and transforming a continuous current of high tension into a continuous current of lower tension, by the employment of a magnetic core, or cores having two sets of wire coils, one of high resistance connected with the main circuit, and one of lower resistance connected with the consumption circuit, the connections of the main and consumption circuits with their respective sets of coils being changed or advanced simultaneously, so that the inductive action of the magnetic core or cores will cause current to flow in the consumption circuit always in the same direction.

3955. "Incandescing electric lamps." T. J. Handford. (A communication from abroad by T. A. Edison.) Dated August 18. 6d. Relates to a mode of connecting the carbon incandescing conductors of electric lamps to the wires which convey current thereto and which are sealed in the glass of the lamp; the object being to produce economically a joint of good electrical conductivity and one not liable to fracture or disunion. In carrying out the said invention

FIG.1.

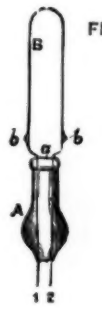
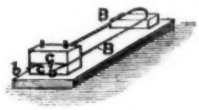


FIG.2.



the enlarged ends of the carbon (which is a flexible filament of specifically high resistance having enlarged ends formed of the same material as the filament itself) are electro-plated with a metal, preferably copper, in a suitable bath as will be well understood. The ends of the leading-in wires, which ends are also preferably of copper, are placed in contact with the electro-plated enlarged ends of the carbon filament and by the use of a blow pipe or soldering iron the metal is fused at the point of junction, so that when cool the wire is attached securely to the metal deposit on the carbon; or the same effect may be accomplished with the use of a solder fused by a blow pipe flame or by means of a hot soldering iron. In using the blow pipe or soldering iron, however, some danger exists that injury may be done to the carbon. In order to prevent this a suitable metal covering is placed over that part of the carbon adjacent to the electro-plated portion, so as to shield it from injury, the electro-plated enlarged ends projecting from such covering. For this purpose the carbon is laid on a block of metal with its ends only projecting beyond the edge, and another block is laid upon it so as to cover a portion of the carbon but leave the plated enlarged ends exposed. Fig. 1 is a view in elevation of the interior parts of an incandescing electric lamp embodying the said invention, and fig. 2 is a perspective view of a suitable apparatus used in carrying out the said invention. A is the interior neck or stem of the lamp, and 1, 2, are the leading-in wires sealed therein at the point *a*. B is the carbon flexible filament, having enlarged ends, *b*, *b* (formed of the same material as the filament), for attachment to the wires 1, 2. In carrying out the present invention the enlarged ends, *b*, *b*, are electro-plated, preferably with copper, and in any suitable manner. The carbon is then placed as shown in fig. 2, with the electro-plated portions, *b*, *b*, projecting just over the edge of the lower portion of the metal block, C, which has pins projecting up from it. The upper half of the block has holes corresponding to the pins, and is set on the lower half, so that the carbon is held between the two, and that portion adjacent to the electro-plated portion is covered up and protected from damage which might occur during the next stage of the process; this consists in placing the ends of the wires, 1, 2, against the electro-plated enlarged ends, *b*, *b*, of the carbon, and melting the metal of both by means of a blow pipe or soldering iron, so that when cool they will be attached together, or a solder may be used to unite the parts.

3961. "Secondary batteries." T. J. Handford. (A communication from abroad by T. A. Edison.) Dated August 18. 6d. The object of this invention is to produce electrodes of metallic lead for secondary batteries, without the use of chemically precipitated lead, or salts, or compounds of lead, which electrodes will be integral throughout, and will present an exceedingly large surface, producing a highly efficient battery by a small reduction to an oxide of the surface of the lead. According to one mode of carrying out this invention, the object required is accomplished by constructing each electrode or the exposed surface thereof of integral aborescent metallic lead. This form of lead is obtained by pouring molten lead from a height into water, or into powdered material such as powdered chalk, or lime, or by blowing air through molten lead. The crystallisation of the lead being disturbed at the moment of setting, the lead assumes an arborescent form, presenting a large surface, and being

integral throughout its mass. This integral aborescent lead may be fused to lead plates, by fusing the surfaces of the plates and pressing the aborescent lead upon them.

3964. "Secondary or storage batteries, &c." H. T. BARNETT. Dated August 18. 6d. The object of the invention is to construct an accumulator which when fully charged will automatically switch itself out of the charging circuit, and which when partially discharged will immediately switch itself in again; also, to provide an attachment which will enable several accumulators to be charged in series, automatically bridging over an accumulator when the latter breaks the circuit, and switching it subsequently again into the circuit, without interfering with any other accumulator that may be in the charging circuit or with any lamps that may be in the circuit of the accumulator.

3971. "Insulating compositions for coating telegraph wires, &c." C. J. ALLPORT and R. PUNSHON. Dated August 19. 2d. The object of the invention is to provide for coating electrical, telephonic, and like wires, compounds which shall be durable, easily applied, not liable to crack, firmly adhesive, and provide good insulation as regards the passage of electric currents therethrough. For the above purpose under the first part the inventors incorporate or mix powdered glass or silica in a finely-divided state and boiled linseed oil in about equal parts, by weight, and coat or cover the wire with the compound in any convenient way. After coating, the compound is allowed to dry. More than one coat may be applied. The wire after each or all the coats is covered with tape, or equivalent material, in the usual manner to prevent injury to the said insulating coating. Under the second part they incorporate or mix equal, or nearly equal, parts, by weight, of powdered glass or india-rubber, or like gum, dissolved in benzole, naphtha, bi-sulphide of carbon, or other suitable solvent, and use the compound produced in the manner set forth under the first part.

3975. "Secondary batteries and electric accumulators." J. E. T. WOODS. Dated August 19. 4d. The objects of this invention are to construct secondary electric batteries and electric accumulators for the storage of electric force or power on new and improved principles so as to make them capable of accumulating, retaining, and subsequently giving off as required a considerably increased quantity of electrical force with largely diminished weights and sizes of the apparatii employed. This is accomplished in various ways by using the electro-chemical affinities of various oxides so as to produce a greater secondary action than is obtained by the arrangements and materials hitherto in use.

3976. "Electric lights." T. J. HANDFORD. (Communicated from abroad by T. A. Edison.) Dated August 19. 6d. The object of the present invention is to produce simple and efficient means for regulating the feed of the upper or positive carbons of arc lamps, more especially designed and adapted for such lamps when arranged in separate multiple arc circuits, and having the cross or multiple arc circuits completed only through the electrodes of the lamp.

3980. "Insulation of wires, &c., used for the production and transmission of electric currents." J. H. JOHNSON. (A communication from abroad by I. M. Hirsh, of Chicago.) Dated August 19. 4d. The said improvements are twofold, and relate firstly to wires to be used in the construction of dynamo-electric or such electric machines as are subjected to an elevation of temperature by reason of resistance to the current in the wires of such apparatus or from other causes. The second improvement relates to wires used external to electric machines and to conductors of currents of electricity above and below earth or water.

3991. "Incandescing conductors for electric lamps." T. J. HANDFORD. (A communication from abroad by T. A. Edison.) Dated August 19. 4d. Relates to new materials and processes, and methods for manufacturing the flexible carbon filaments of incandescing electric lamps, having a specially high resistance. According to one mode of carrying out this invention, there is employed a carbohydrate, such as pure unstructural cellulose, or some compound thereof, which is formed into filaments and carbonised, or first carbonised and then made into filaments.

3995. "Underground conductors for electrical distribution." T. J. HANDFORD. (A communication from abroad by T. A. Edison.) Dated August 21. 6d. It has been proposed heretofore in laying the conductors for a multiple arc system of electrical distribution to connect the intersecting conductors at each crossing of two streets at four points by running them into four junction boxes located at the corners of the blocks or squares, the positive conductors being in this way all connected together, and likewise all the negative conductors, the whole forming a double network of intersecting and connected conductors. Each tube was run into a separate box near each corner, and a fusible conductor or "safety catch" placed in the line of one or each conductor. The object of the present invention is to arrange and connect the conductors at the intersection of two streets in a more convenient manner, making them more accessible for repairs of connections, replacement of "safety catches," or for testing purposes.

4003. "Safety devices for use with electric apparatus to diminish fire risks." SILVANUS P. THOMPSON. Dated August 21. 4d. The objects of this invention are means or devices designed chiefly for insuring greater safety from fire than has been heretofore attainable in the use of electric currents for lighting, telegraphing, and for kindred purposes. (*Provisional only.*)

4036. "Winding coils of wire upon the armatures of dynamo-electrical machines." W. B. ESPEUT. Dated August 23. 6d. Has for its principal object to effect by machinery or apparatus, the winding of coils of wire upon the armatures of dynamo-electrical machines, which operation has hitherto been effected by hand.

4079. "Secondary batteries, &c." L. H. SOMZÉE. Dated August 25. 6d. Consists, firstly, in forming the elements of the battery by coating very thin lead sheets, perforated or not, on both sides with a slight thickness of minium, rendered adherent by mixing it with starch, gelatine, or any other agglutinative substance, by then connecting and maintaining at convenient distances any number of these sheets by means of insulated cross pieces, and by surrounding the whole with a lead sheet of greater thickness and provided with larger openings, whereby a box open on all its sides will be formed. Consists also in the use instead of pumice stone of a light and porous coke, charcoal, or asbestos, into which the minium is so to speak cast. To this end the particles of coal or carbon—which may be previously impregnated with lead by introducing them into a solution of acetate of lead and by reviving the metal by electrolysis or by heat—these particles, metallised or not, are placed in a receptacle and covered with a thickness of minium or lead powder, or any other suitable oxidised or sulphuretted metal, which is stamped or pressed into the consecutive interstices of the spongy coal fragments and into the fragments themselves. Consists also in rendering the elements compact and porous at the same time by mixing pulverised charcoal and minium together with sugar, syrup or any other agglutinative matter, so as to form a tough paste, which is carried to a suitable heat, then cooled down under pressure, and, if necessary, slowly reheated again, in order to rid the block of any volatile products and augment its porosity.

CITY NOTES, REPORTS, MEETINGS, &c.

Indo-European Telegraph Company (Limited).

THE annual report of the directors, for 1882, which will be submitted at the meeting of the company on the 30th inst., shows a total revenue of £118,132 9s. 3d. The expenses were: On commercial and general account, £27,239 4s.; on maintenance account, paid to Messrs. Siemens, £21,125 1s. 11d.; paid to the Russian Government, £246 7s. 1d.; and outlay of the company, £10,037 15s. 1d.; in all, £31,409 4s. 1d. Deducting the above expenses, taking credit for £500 16s. 6d. balance brought over from 1881, and debiting income-tax, there remains the sum of £59,130 0s. 6d. From this amount the directors have placed £5,000 to the reserve, and that sum, together with £10,625, amount of interim dividend paid, have to be deducted, leaving a balance of £43,505 0s. 6d. On taking over the maintenance, the company purchased from Messrs. Siemens Brothers all their stores in good order and condition available for repair of the Company's line. The cost of these amounted to £6,425 11s. 8d. New freehold buildings at Teheran and elsewhere have also been taken over and purchased by the company at a cost of £1,876. The shareholders will remember that in their report for the year 1874 the directors stated that the India Office had agreed to discontinue the arrangement by which, in lieu of the Persian Debt being exclusively liquidated by annual deductions made by the company from the royalty payable by the company to the Persian Government, the profits of the company, earned on the Teheran-Bushire section of the line in Persia, were to be set aside for the more speedy liquidation of the debt. The India Office, under the power they had reserved to themselves, last year gave the company notice that, owing to its improved financial position, the above profits, as calculated from the 12th of August, 1882, were again to be set aside for payment to them on account of the Persian Debt. Under this notice a sum of £6,416 3s. 11d. has been paid on account of the year 1882. This amount, as explained in the directors' report for the year 1870, and in subsequent reports, is in the nature of a reserve fund, as it will be repaid by annual deductions made by the company from the tribute payable to Persia. The three items above enumerated amount together to £14,717 15s. 7d. The board were of opinion that, looking to the abnormal prosperity of the financial year 1882, the shareholders would coincide with them in the prudence of meeting these charges out of the revenue of the year. This course will benefit future years, and strengthen the company's position. This leaves a balance of £28,787 4s. 11d. to be dealt with, and the directors propose the declaration of a dividend for the last six months of 17s. 6d. per share, making, with the interim dividend already paid, 6 per cent. for the year, and a bonus of 15s. per share, both free of income-tax, making in all 9 per cent. for the year. The balance of £1,162 4s. 11d. will be carried to the credit of 1883. The directors have much pleasure in reporting that they have secured upon favourable terms an extension of the company's Persian concession for ten years. The company has leased from the Post-office a special wire from its central office in London to Manchester and Liverpool, in which places offices of the company were established and opened in the autumn of 1882. The maintenance by the company of its own lines is working satisfactorily. Owing to the operations of the war in Egypt, the lines of the Eastern Telegraph Company to India, Trans-India, and South Africa, were totally interrupted for nearly three months. During this period the whole of the business between Europe and America and the above parts passed over the lines of this company, and of the Indo-European Government Telegraph Department, and the work was performed so satisfactorily as to permit of an increase of 12 per cent. in the gross take of the Indian and Trans-Indian business. The directors congratulate the shareholders upon this satisfactory result, and they desire to say that under somewhat similar circumstances they have been indebted to the Eastern Telegraph Company, thus showing the value of the joint-purse arrangement to both companies.

The Maxim-Weston Electric Light Company, Limited.

THE second annual ordinary general meeting of this company was held at the Cannon Street Hotel yesterday, at which the following report of the directors for the year ended 31st March, 1883, was submitted:—

"As since last report a very large change has taken place in the

holders of shares, they deem it necessary again to refer to the large sum that has been expended in the purchase of the various patents in possession of the company. This amounts to £113,819 15s., a considerably larger sum than was contemplated at the inception of the company, but which became necessary for the purchase of the Maxim and Weston patents, this expenditure having been sanctioned by the shareholders; and the directors believe the company now possesses the most valuable patent rights extant for electric lighting. In this belief they are confirmed by universally expressed opinion, and time only is required for the systems to be as extensively adopted here as in America. The recent Electric Light Bill has not been of benefit to electric light companies (owing to vestries and corporations not yet being in a position to take advantage of its provisions), and other causes have tended to obstruct the use of electricity for lighting purposes. But the directors feel convinced that only further time is necessary to bring it into general use; and, meantime, most valuable improvements have been made in the lamps and dynamos, expenditure curtailed to the utmost, a number of agents appointed, and the company put in a position to undertake the most extensive contracts immediately when obtained. As some evidence of this, it may be stated that contracts have recently been made with the Science and Art Department for the lighting of the Bethnal Green Museum, with Messrs. Kirk and Randall for the new dock works at Tilbury, with the proprietors of Astley's and the New Grand Theatres, independently of lesser lighting contracts. Several others of an extensive character are now pending, with every prospect of being satisfactorily completed. In addition to this business, an agreement has been concluded with an influential syndicate for conditional concessions for the various Australasian Colonies, and there is a probability of the company realising from these concessions the sum of £17,000 in cash. The Lancashire company is making satisfactory progress, and has every prospect of a profitable career. For this concession £10,000 worth of fully paid-up shares have been received from that company, and when the unallotted shares are disposed of, a further sum of £10,000 in cash becomes payable. £19,625 in shares have already been received for concessions or infringements of the company's patents, many of these shares being of undoubted value, and requiring only time to make them saleable at par. The value of the stock, &c., at the factory and at the various centres of installation, amounts to the sum of £21,372 12s. 3d., and that of the lease, buildings, and furniture to £2,390 16s. 9d. Everything is in a sound workable state, and a most efficient staff has been organised capable of undertaking any descripton of lighting, and at a cost for wages which will compare favourably with any other company. The present contracts for lighting Queen Victoria Street and Southwark Bridge and for Pentonville Road are in a satisfactory condition, and there is a probability of both being considerably enlarged on remunerative terms. The company is now undertaking no unremunerative contracts. The directors feel greatly disappointed in not being able to make a more favourable report on this occasion, chiefly owing to the adverse tide which set in last year, but derive some satisfaction from the fact that their lamps and dynamos remain unsurpassed in excellence, that they can now offer these at prices as low as other companies, and that the demand for them is rapidly increasing. Nearly the entire capital is represented in patents, plant, and shares, so that it is evident that unless more capital is raised, the operations of the company must be restricted to a point at which no dividend could be available. With additional capital, the directors see their way to a large and profitable business in the immediate future, and have still nearly the whole of Britain and the Colonies to concede as in the case of Lancashire. With this view they have thought it desirable to submit for the consideration of the shareholders a proposal to increase the nominal capital of the Company to £500,000, to be issued as required. This will enable the directors to extend the company's operations to the numerous towns and districts still unrepresented, and pave the way for concessions. They also propose to commence the manufacture of dynamos, which must prove a lucrative source of revenue. In view of all the circumstances, the directors feel that they can safely recommend the shareholders to subscribe towards the new issue, which they propose should be made at current market price, as this will, in their opinion, have the effect of speedily enhancing the value of their present holding. It is intended that the new shares shall be first offered to the existing shareholders. Since the last meeting, there have been important changes in the management and staff of the company, resulting in a very large reduction of the annual expenditure, greater efficiency, valuable improvements in and a much larger production of Maxim and Weston lamps, fittings, &c. Mr. Hugh Watt has accepted the appointment of managing director, and to his energy and ability are to be attributed most of the advantages gained by the changes enumerated."

An extraordinary general meeting of the company was also held yesterday at which the following resolutions were proposed:—"That the nominal capital of the company be increased by the addition thereto of 327,500 shares of £1 each, beyond the registered capital of £172,500, in 172,500 shares of £1 each, making the total capital £500,000, and that such 327,500 shares may be allotted at the discretion of the directors, on such terms and at such times as they think fit, and either at a premium or at a discount."

The Eastern Extension, Australasia and China Telegraph Company (Limited).

The nineteenth ordinary general meeting of this company was held at the City Terminus Hotel, on Wednesday, Mr. John Pender, M.P., the chairman, presiding.

The Secretary (Mr. F. E. Hesse) read the notice convening the meeting, and the report of the directors, an abstract of which we have already published, was taken as read.

The Chairman said, as usual he should refer to some of the leading points in the report so as to show them clearly the fluctuations which had taken place during the past six months. The gross receipts in the half-year had amounted to £209,131, against £205,963, in the corresponding period of 1881, showing an increase of £3,168. The working and other expenses absorbed £54,782, against £51,643 in the corresponding period of 1881, being an increase of £3,139, which was principally caused by extra stations costs in consequence of increased travelling expenses having been incurred in bringing home and shifting about the foreign staff, and also by an increased expenditure in cable repairs. The net revenue amounted to £110,755, against £76,970, showing an apparent increase of £33,785. During 1881 a sum of £34,000 was taken from the revenue towards the renewal of the Batavia cable, to which he fully referred at the last meeting, and consequently the net revenue for the half-year was practically the same as during the corresponding period of 1881. If however the figures for the whole year were considered the following satisfactory results were shown:—Gross receipts for 1882, £416,250, and for 1881, £397,543, being an increase of £18,707. (Hear hear.) The working expenses for 1882 were £105,137, and for 1881, £105,741, a decrease in last year of £604. The net revenue for 1882 was £194,148, and in 1881, £171,725, an increase in 1882 of £22,423. In the past half-year 1¼ per cent., amounting to £24,968, had been paid, and it was now proposed to distribute another dividend of a like amount, together with a bonus of 2s. per share, which, with the previous payment of the first half-year would make a total distribution of 6½ per cent. for the year 1882 against 6 per cent. for the year 1881. (Hear hear.) The sum of £64,311 had been added to the reserve fund during the year, increasing it to £351,033. The sum of £30,000 had been taken from the reserve fund during the year, besides £34,000 in the previous year, towards the renewal of the Singapore and Batavia cable, otherwise the reserve fund might have been increased by that amount, or a portion of it applied in increased dividends and the balance carried to the reserve fund. Within the last few days and since the accounts were printed, the directors had added a further £100,000 to the reserve fund, £50,000 being the earnings of the company, and £50,000 being the premium which they made upon the issue of their shares (hear, hear), so that they would observe that their reserve fund was getting to a very goodly sum indeed. (Hear, hear.) They had also spent out of the revenue during the last four years, in addition to the sums he had already alluded to, £35,585 in renewing various portions of the company's cables, involving an expenditure of 1,800 knots of cable. At the same time they had picked up 1,600 knots, which had been put into the cable account at a depreciated value. That had been done to improve their cables and to strengthen their position as a dividend-paying concern. Their system consisted of 11,250 knots of cable, of which about 1,800 were more or less exposed to the action of the teredo, but he thought they had so far, at any rate, conquered it at last. They had not added a shilling to their capital in improving their system. Of the 1,800 knots which were exposed to the teredo, 825 had been replaced by brass ribbon cable, which up to the present time had successfully resisted the ravages of that insect, so that there were now about 1,000 knots to be replaced. They proposed doing that gradually. He might mention that the 50,250 shares which were issued were readily taken up by the shareholders at £1 premium, and since the report had been issued the committee of the Stock Exchange had granted a special settlement and quotation for the shares. So far as figures went he had shown them a very good account of their affairs; and he might say, looking to the fact that they had so far secured themselves against the teredo and to the amount they now had in the reserve fund—with the immediate prospect of seeing their reserve fund stand at half a million sterling—he thought it would not be too sanguine of them to expect—if they had the same success during the next six months as they had during the last—to probably be able to add as much to the dividend next year as they had done in the past (hear, hear). There was a question to which he had to refer which was personal to the board and to himself. Some twelve or eighteen months ago Colonel Glover, who was the managing director, in receipt of £1,500 a year, died. He (the chairman) stated on that occasion that he hoped the directors would be able to conduct the affairs of the company with perfect satisfaction to all concerned without appointing a managing director. He thought he might say they had done that very successfully, for perhaps in no period in the company's history had it been more successful than during the past eighteen months. The directors therefore thought it would not be taking too great a liberty with the shareholders, having saved them £1,500, if they should revert to the original sum which was granted to the directors, namely, £4,000 a year. (Hear, hear.) They reduced that amount for a considerable time when they were not paying so high dividends, but now that they were giving to the shareholders a fair and increasing dividend, they thought it was not unjust the directors should share with them a little. (Hear, hear.) He hoped the shareholders would not grudge them that which they had taken the liberty of placing in the accounts. (Hear, hear.) During the year they had had to make several repairs as usual, and fortunately they were in a position to meet the expenses of these repairs. Since he last addressed them they had carried out a very successful enterprise in establishing a cable from Hong Kong to Shanghai. They had had a joint-purse arrangement for the last ten or twelve years with the Great Northern Company; but as they had found from experience that one cable did not give that permanent service which they now desired to give to those who used submarine telegraphs, and as there was a very strong expression of opinion amongst the commercial community at Shanghai that the existing cable was not giving them the service they were entitled to, and a movement among the merchants to work a cable between Hong Kong and Shanghai, he communicated with the Great Northern Company, stating that the time had now come when it was necessary the system should be duplicated and that they had determined to do it. There was great opposition to this, but they had now entered into a fresh treaty with the Great Northern

Company for a considerable number of years, and the Eastern Extension was to share with them all the privileges which they held north of Shanghai, and they were included now, which they were not before, in the Japanese traffic. Their system, he thought, would be open in a few days, and he looked for considerable fruits from that important negotiation and arrangement. They had an important station at Hong Kong. The Chinese were likely to carry their inland system to Canton, and they had made arrangements whereby they should be connected with the system. They had also entered into negotiations for carrying their system from Penang to Bangkok, the capital of Siam. They had got a concession for, he believed, forty years, which ought to give them a traffic that would pay them for the expense they were going to in carrying out the work. He moved "That the report and accounts of the directors now submitted be received and adopted, and that a dividend be now declared of 2s. 6d. per share, together with a bonus of 2s. per share, both free of income-tax, payable on the 18th inst., making, with the previous distribution, a total premium of 6½ per cent. for 1882."

The Marquis of Tweeddale seconded.

Mr. Griffith said it occurred to him now that they had so large a reserve fund whether it would not be advisable in future, instead of adding to that fund, to use their surplus revenue to pay off some of the debentures. He thought they were all indebted to the directors for what they had done, and he hoped they would show their gratitude by agreeing to the remuneration the chairman had asked.

The Chairman did not think it would be prudent in them to use their reserve fund, which was a grand stand-by, as suggested.

Mr. Newton thoroughly approved of their granting the directors the remuneration the chairman had asked for; but he did object to the principle of doing away with a managing director. That company could well afford to pay a managing director handsomely as well as the other directors, and considering the position it had attained he was of opinion that they ought to have a managing director.

The Chairman explained that all the directors, including himself, paid great attention to the affairs of the company and worked together harmoniously; and in the meantime, at any rate, he thought he was justified in his suggestion. If he saw that the interests of the company were suffering in the slightest degree in the course he was pursuing, he would agree with Mr. Newton. He wished the directors, individually as well as collectively, to feel there was a responsibility resting on their shoulders, and of it he did not wish to relieve them at present.

The motion was unanimously adopted.

The Chairman and the Marquis of Tweeddale, who retired by rotatiod, were unanimously re-elected directors of the company.

Mr. Henry Dever and Messrs. Quilter, Ball & Co., the retiring auditors, were re-elected at an increased salary of £50 each per annum.

The usual votes of thanks closed the meeting.

The Great Western Electric Light and Power Company (Limited).

On the 14th February last, Mr. W. Ladd resigned his seat at the board of this company, and issued a circular to the shareholders stating that he could no longer work with the three remaining directors, and explaining that two of them had from December 13th to January 17th last received £101 17s. 6d. in fees and rail and hotel charges. To this expenditure of the company's money Mr. Ladd was opposed. In accordance with a requisition from the shareholders, an extraordinary meeting was held at the City Terminus Hotel, on Tuesday, for the purpose of considering, and, if deemed desirable, passing certain resolutions as to the management of the company. Mr. Stewart brought forward a motion asking the present directors to resign, and it having been put to the vote, was declared not carried by a majority of 2, 17 being for and 19 against. A poll was demanded, which will take place on Tuesday next, at the offices of the company, from twelve till two o'clock. We believe 10,000 out of a possible 23,000 proxies have already been obtained by Mr. Stewart in favour of his resolution. An extraordinary general meeting was held on the 29th ult., when the following resolutions, which were passed at the extraordinary general meeting held on the 6th ult., were confirmed:—"That the capital of the company be reduced from £250,000, divided into 50,000 shares of £5 each, to £195,000, divided into 28,000 shares of £5 each, and 22,000 shares (Nos. 3,001 to 25,000) of £2 10s. each, and that such reduction be effected by reducing each of the said 22,000 shares by the amount uncalled thereon, or £2 10s. per share;" and "That the 25,000 unissued shares of £5 each be subdivided into 50,000 shares of £2 10s. each, and that the 3,000 fully paid-up shares of £5 each, numbered 1 to 3,000, be subdivided into 6,000 fully paid shares of £2 10s. each."

The River Plate Telephone and Electric Light Company (Limited.)

—This Company has removed its offices to 34, Walbrook, E.C., and Mr. R. H. Krause has been appointed secretary.

The Direct United States Cable Co. (Limited).

—The directors recommend an interim dividend of 5s. per share, being at the rate of 5 per cent. per annum, for the quarter ending March 31, payable on May 16.

Great Northern Telegraph Company of Copenhagen.

—The working account of this company for 1882, which has now been issued, shows the total receipts, including a balance of £19,688 18s. 7d. from 1881, to be £276,544 3s. 5d. The total expenses were £71,214 18s. 6d.; interest on and amortisation of debentures, £9,750; dividends paid £120,833 6s. 8d.; addition to reserve and renewal fund, £55,555 11s. 1d; addition to pension fund of the staff, £1,111 12s. 3d; and remuneration to the board of directors, £1,500; in all £259,964 18s. 6d., leaving a balance of £16,579 4s. 11d. to be carried forward to this year.

The West Coast of America Telegraph Company (Limited).

—This company notifies a reduction of tariff *vid* Galveston (United States) to Buenos Ayres and all stations in the Argentine Republic. Tariff from Great Britain to Buenos Ayres, and all stations in the Argentine Republic, is now 13s. per word.

Oriental Telephone Company (Limited).

—The shares of this company number 225,000 ordinary of £1 each, on which 10s. per share has been paid, and 75,000 deferred of £1 each fully paid; and the Stock and Share Auction and Advance Company (Limited), now offer 10,000 of the deferred shares at 10s. per share, being a discount of 50 per cent. These shares, it is advertised, will rank equally with the ordinary for dividend, when six per cent. for five years (or 30 per cent. in all) has been paid. This only involves an amount of £33,780, from which must now be deducted dividends already paid.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid	Closing Quotations.. April 18	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	7	5½ - 6	5¹³/₁₆.13/16
		Do. Do.	10	7½ - 8½	8¼
30,000	5	Australasian Electric Light, Power & Storage Co.	3	¼ - ½	
24,000	10	British Insulite Co., Limited, "A" Shares	5	1½ - 2½	2
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	¼ - ½	
25,000	5	Great Western Electric Light & Power Co.	2½	¼ - ½	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	2½ - 3½	
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	¼ - ½	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	½ - ¾	½
..	..	Metropolitan Brush Electric Light & Power Co.	3	..	
40,000	5	Pilsen-Joel & General Electric Light Co	2	½ - 1	½
..	..	South African Brush Electric Light & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Limited	2½	1½ - 2½	2
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	51 - 52	xd.
2,441,800*l.*	Stk.	Do. Preferred { Def'd. receiving no div. until }	100	83 - 84	83¾ xd.
2,441,800*l.*	Stk.	Do. Deferred { 6 p. c. has been paid to Pref. }	100	20⅞ - 21¼	20¹³/₁₆.1
130,000	10	Brazilian Submarine, Limited	10	12⅜ - 12⅝	12⁹/₁₆
16,000	10	Cuba, Limited	10	10 - 10½	
6,000	10	Do. 10 per cent. Preference	10	17 - 18	
13,000	10	Direct Spanish, Limited	9	5½ - 5⅝	5⅝
6,000	10	Do. 10 per cent. Preference	10	15½ - 16½	
65,000	20	Direct United States Cable, Limited, 1877	20	12½ - 13⅛	12¹³/₁₆.13¹/₁₆
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	99 -102	xd.
380,000	10	Eastern, Limited	10	10¾-11 ¼	10⅝.11.10⅞ xd.
70,000	10	Do. 6 per cent. Preference	10	13¼ - 13⅜	13¼.⅞ xd
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	98 -101	xd.
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	104 -107	
199,750	19	Eastern Extension, Australasia & China, Limited	10	12½ - 12⅝	12¼.⅝.¼
50,250	8	Do. New Shares, 1883	8	8¼ - 8⅜	8¹³/₁₆
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	103	107 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	104 -107	
140,000	100	Do. do. registered, repayable 1900	100	104 -107	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	103 -106	
254,300*l.*	100	{ Eastern and South African Limited 5 per cent. }	100	103 -106	
345,700*l.*	100	{ Mort. Deb. Registered redeemable 1 Jan 1900 } Do. do. do. To Bearer	100	103 -105	
22,050	10	German Union Telegraph and Trust, Limited	10	10 - 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6⅞ - 7⅛	7⅛.¼
163,206	10	Do. 6 per cent. Preference	10	12⅝ - 13⅛	
125,000	10	Great Northern	10	12⅝ - 13⅛	13⅛.⅞
100,000*l.*	100	Do. 5 per cent. Debentures	100	101 -104	
300,000	100	Do. 5 per cent. Debentures	100	101 -104	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	28½ - 29½	
100,000	100	Do. 6 per cent. Debentures, 1886	100	103 -106	
17,000	25	Indo-European, Limited	25	32 - 33	
38,148	10	London Platino-Brazilian, Limited	10	4¼ - 4⅝	
12,060	10	Mediterranean Extension, Limited	10	1¾ - 2	
8,200	10	Do. 8 per cent. Preference	10	6½ - 7½	
9,000	8	Reuter's, Limited	8	9½ - 10½	
280,000	Stk.	Submarine	100	247 -252	
58,225	1	Do. Scrip	1	2 - 2⅛	
4,200	Cert.	Submarine Cables Trust	100	106 -110	
37,350	12	Telegraph Construction and Maintenance	12	34½ - 35½	35⅜.5.4½.5¼
150,000	100	Do. 6 per cent. Bonds, 1884	100	101 -103	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1⅛ - 1⅜	
30,000	10	West Coast of America, Limited	10	4½ - 5	
150,000	100	Do. 8 per cent. Debentures	100	107 -109	
69,910	20	Western and Brazilian, Limited	15	7⅜ - 7½	
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	106 -110	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100	100 -103	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building)Bds.	$1,000	125 -128	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	103 -106	
88,321	10	West India and Panama, Limited	10	1⅛ - 1⅜	
34,563	10	Do. 6 per cent. 1st Preference	10	7⅛ - 8⅛	
4,669	10	Do. 6 do. 2nd do.	10	5½ - 6½	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	½ - 1	¹³/₁₆
225,000	1	Oriental Telephone Co., Nos. 80,001 to 300,000	¼	⅛ - ¼	
100 000	5	United Telephone Co.	5	10 - 10½	

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company. The traffic receipts for the week ended April 6th amounted to £3,521, and for the week ended the 15th £3,792.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ended April 6th, 1883, were £2,342, and for the week ended the 13th, £2,474, each after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Co., Limited.

The West India and Panama Telegraph Company, Limited. The estimated traffic receipts for the half month ended April 15th, are £4,026, as compared with £3,754 in the corresponding period of 1882.